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Groundwater/Vadose Zone Integration Project Specification

United States
Department of Energy
Richland, Washington

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EXECUTIVE SUMMARY

The Groundwater/Vadose Zone Integration Project (Integration Project) coordinates and integrates Hanford Site work scope that could have an impact on water resources, to assure that the U.S. Department of Energy (DOE) Richland Operations Office (RL) goals of stewardship and protection are attained. The Integration Project's vision centers on establishing trust and collaboration among participants and stakeholders in Hanford Site cleanup work in order to develop credible, defensible decisions that protect water resources. The Integration Project's mission is to ensure protection of human health and the environment throughout the Hanford Site, including protection of the Columbia River environment, river-dependent life, and users of Columbia River resources.

In late 1997, RL established the Integration Project and directed Bechtel Hanford, Inc. (BHI) to lead the Integration Project. Fluor-Daniel Hanford, Inc. (FDH) and Pacific Northwest National Laboratory (PNNL) are key members of the project team, applying significant technical expertise and resources to the effort, and helping to ensure close coordination with site programs, contractors, and other involved entities. RL has also tasked BHI with facilitating the close interaction and the active participation of regulators, stakeholders, Tribal Nations, and interested members of the public, as this is fundamental to the Integration Project's success.

The primary function of this document is to define the purpose, function, and scope of the Integration Project. The vision, mission, goals, objectives and technical scope of the project are described in this *Project Specification*. The values that frame the project are described, and the controlling requirements are identified. A general description of the project strategy and approach are presented, although these elements will be more fully developed in subsequent documents. Finally, the logic used to assign Integration Project work priorities is outlined in this *Project Specification.*

This document is one of four baseline documents for the Integration Project. An important secondary function of the document is to identify the project documents that address requirements of the *Groundwater Protection Management Plan,* as identified in DOE Order 5400.1.

Federal and Washington State law, legally-binding agreements between DOE and the state, and congressional mandates are requirements that control and constrain activities that fall within the purview of the Integration Project. Values and recommendations expressed by Tribal Nations and various stakeholders also provide guidance for defining activities. Frequently expressed values and recommendations are include the following:

- Protect the resources of the Columbia River from degradation caused by Hanford Site contaminants.
- Integrate activities associated with the vadose zone, groundwater, and Columbia River, so that all activities are addressed efficiently and cost effectively.

- Keep Tribal Nations and interested stakeholders fully informed on progress and involve them in planning activities.

- Use independent technical expertise and peer review to add impartiality and credence to planned activities, interpretations, and proposed decisions.

In order to achieve the project vision and meet the project mission, a wide spectrum of activities must be captured within the goals of the Integration Project. The most comprehensive set of Hanford Site goals that have applicability to the project are contained in the *Hanford Strategic Plan*. A subset of these goals have been adopted by the Integration Project, and these will be supplemented if they are found to be insufficient.

Integration Project objectives include the following:

- Develop assessment methods for human health and ecological risk that support near- and long-term cleanup decisions. Evaluate the sustainability of the river ecosystem, the cultural quality of life, and socioeconomic impacts over the period of time that Hanford-derived contaminants remain potentially hazardous.

- Instill a credible technical basis for Hanford Site cleanup decisions through the use of applied science and technology.

- Provide a platform for making informed and consistent management decisions throughout all Hanford Site Programs.

- Be open and responsive to the regulators, stakeholders, the public, and Tribal Nations.

There are seven tenets that comprise the strategy for accomplishing the Integration Project's mission. (1) *Activity Integration* is accomplished by evaluating technical information and data needs, and various capability needs, to identify knowledge gaps, overlapping projects, and inefficiencies. (2) *Work Control* is established by technical review/approval authority, and by providing a key advisory role to DOE in regulatory decisions. (3) *Decisional Timeframes* recognizes that different requirements and controls apply to the various timeframes within which decisions must be made. (4) *Applied Science* brings in the appropriate technical resources to solve key technical problems or to develop critical technical capabilities. (5) *Independent Review Process* uses multi-level reviews by external, independent organizations and individuals. (6) *Establishing Work Priorities* is accomplished by identifying criteria for work scope performance, scheduling, and funding needs. (7) *Open Process* reflects the Integration Project's value of open communications, active participation, and exchange of information and ideas among all interested parties and participants.

The Integration Project technical scope is defined in terms of nine technical elements, functional groupings of which represent (1) *technical information and data needs*, (2) *methods and capabilities*, (3) *controls and constraints*, and (4) *integration*. Technical work scope refers to the subject matter, geographic boundaries, methods (etc.) that are associated with each technical element. The elements are interdependent and cover time scales associated with near- and intermediate-term decisions involving cleanup activities, and with long-term issues associated with conditions that might evolve well into the future.

Technical information and data needs include the technical elements inventory, vadose zone, groundwater, and the Columbia River. Principal aspects of the work scope are characterization of features and processes, to develop conceptual models of the natural systems and how they accommodate contamination. Observational data and output from numerical models are used to develop information for conceptual models.

Methods and capabilities are represented by the technical elements monitoring and risk assessment. Monitoring work scope pertains to data collection methods and logistics. Risk assessment pertains to using currently accepted or mandated methods, as well as developing new methods for specific scenarios.

Controls and constraints are addressed in the regulatory path and remediation options elements. These elements contain the drivers for technical work that is primarily associated with near-term environmental protection and remediation decisions. Drivers are expected to evolve as waste management, cleanup, and restoration activities proceed at the Hanford Site.

Integration is the heart of the Integration Project and is represented by the system assessment technical work element. Work scope includes responsibility for quantifying the environmental consequences of past, present, and future DOE-sponsored Hanford Site activities in the vadose zone, groundwater, and Columbia River. Analysis and assessment methods will be developed that apply to a variety of temporal and spatial scales. New information and data will be evaluated relative to Integration Project goals. Technical differences among the other elements will be reconciled.

The Integration Project seeks to remedy the fragmentation inherent in past approaches to characterization and assessment of impacts regarding contamination at, or originating from, the Hanford Site. The general approach is to (a) identify organization overlaps and other inefficiencies; (b) identify deficiencies in knowledge and the work needed to fill those deficiencies; and (c) using information gained from (a) and (b) to expeditiously implement appropriate remedies.

Four steps are followed to create an annual detailed work plan: Project Definition, Deficiencies Assessment, Work Scope Definition, and Work Scope Approval. (1) *Project Definition* includes the key documents that define the projects' scope, requirements, strategy, roles, responsibilities, and participation. (2) *Deficiencies Assessment (formerly called "Gaps")* consists of a systematic evaluation of technical information needs and capabilities; results are documented in the *Project Baseline.* (3) *Work Definition* uses the results of the Deficiencies Assessment to identify work scope and prioritize activities, to ensure that the appropriate information is available when needed, and that public funds are spend effectively and efficiently. (4) *Work Review and Approval* is the process by which proposed work scope and priorities are subjected to internal and external, independent review prior to approval. The process is open to public comment.

The principal decisions to be made by the Integration Project in setting work scope priorities are (1) what work is needed; (2) how the work is to be accomplished; (3) when is it needed; (4) where the work will be applied; and (5) for what purpose. The Hanford Site's general criteria for establishing the priority of any project are as follows:

- Establish and maintain safe operations.
- Maintain essential services.
- Mitigate urgent risks.
- Ensure compliance with all applicable laws, regulations, DOE orders, agreements, consent orders, and Defense Nuclear Safety Board recommendations.

The Integration Project will develop additional criteria using input from expert panels and preferences expressed by stakeholders, Tribal Nations, and the interested public. Criteria for assigning work priority will be based on the following:

- Cost and funding availability
- Scheduling, as constrained by logistics and regulatory requirements
- Alternatives for obtaining the information
- Alternatives that might obviate the need for the information
- Risk-based mitigation urgency
- Risk-based remediation urgency
- Contingencies.

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ACRONYMS

AEA	Atomic Energy Act
ALARA	As Low As Reasonably Achievable
ARAR	Applicable or Relevant and Appropriate Requirements
AME	Assistant Manager for Environmental Restoration
ASME	American Society of Mechanical Engineers
BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CRCIA	*Columbia River Comprehensive Impact Assessment*
CRU	Columbia River United
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DOE	U. S. Department of Energy
DWP	*Detailed Work Plan*
DWS	Drinking Water Standards
Ecology	Washington State Department of Ecology
EMSL	Environmental Molecular Sciences Laboratory
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERA	Expedited Response Action
ERC	Environmental Restoration Contractor
ERDF	Environmental Restoration Disposal Facility
FDH	Fluor Daniel Hanford, Inc.
FSUWG	Future Sites Uses Working Group
GPMP	*Groundwater Protection Management Plan*
GW/VZ	Groundwater and Vadose Zone
HAB	Hanford Advisory Board
HEAL	Hanford Environmental Action League
HRA-EIS	Hanford Remedial Action Environmental Impact Statement
HQ	Headquarters
IPL	*Integrated Priority List*
IRM	Interim Remedial Measures
LRP	*Long Range Plan*
MOAs	Memoranda of Agreement
MOUs	Memoranda of Understanding
MTCA	*Model Toxic Control Act*
NAS	National Academy of Sciences
NPT	Nez Perce Tribe
OBS	Organizational Breakdown Structure
OST	Office of Science and Technology
PBS	*Program Baseline Summary*
PHMC	Project Hanford Management Contract
PM	Project Manager
PMP	*Project Management Plan*

Acronyms

PNNL	Pacific Northwest National Laboratory
PTS	Progress Tracking System
RCRA	*Resource Conservation and Recovery Act*
RL	Richland Operations Office
ROD	Record of Decision
STCG	Science and Technology Coordinating Group
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	Treatment, Storage, and Disposal
TWRS	Tank Waste Remediation System
YIN	Yakama Indian Nation
WBS	Work Breakdown Structure

1.0 INTRODUCTION

The Groundwater/Vadose Zone (GW/VZ) Integration Project (Integration Project) coordinates and integrates work scope that evaluates the impact of Hanford Site contamination on human health and the environment, in order to assure that the appropriate goals of water resources stewardship and protection are attained.

The Integration Project was conceived by the U.S. Department of Energy (DOE) in late 1997. The Assistant Manager for Environmental Restoration (AME) at the Richland Operations Office (RL) was assigned responsibility for the Integration Project. In December 1997, Bechtel Hanford, Inc. (BHI), which leads the Hanford Site Environmental Restoration Contractor (ERC) team, was assigned the responsibility for planning site-wide GW/VZ activities. Other major Hanford Site participants in the planning activities are Fluor Daniel Hanford, Inc. (FDH), which is integrating contractor for the Project Hanford Management Contractor (PHMC), and the Pacific Northwest National Laboratory (PNNL). BHI was also directed to actively involve Tribal Nations, regulators, and other stakeholders.

1.1 VISION

A vision statement has been framed to express a view of what might evolve from successful implementation of the GW/VZ Project:

Integration activities have established broad trust and collaboration that have resulted in credible decisions, based on defensible science, that effectively and efficiently protected water resources.

To achieve this vision, the Integration Project, with the help and concurrence of interested stakeholders, will define the work to be performed and establish the priorities for completing the work. Experts who are independent of the Hanford Site will review the work scope for its technical adequacy and appropriateness to achieve project objectives.

1.2 MISSION

The DOE has received extensive commentary and expressions of concern from Tribal Nations, Washington state and federal regulators, environmental advocacy groups, and the public. These concerns convey expectations for managing Hanford Site waste inventories and addressing contamination that has entered the environment. Among the frequently-cited concerns are the following:

- Participants in the Hanford Site cleanup must align themselves toward common cleanup goals to protect groundwater and Columbia River resources.

- Planning and priorities must be oriented toward achievable near- and long-term objectives.
- Agreed upon actions must be adequately funded and efficiently managed.
- Progress, as well as problems, must be openly communicated to stakeholders.
- Management roles, responsibilities, and processes must be accessible for evaluation by stakeholders and must protect the environment.
- The DOE must be accountable for its actions in managing the Hanford Site.

Numerous values are inherent in these concerns, including (1) a focus on understanding the Hanford Site's waste and environmental contamination problems; (2) openness, honesty, and responsiveness in the exchange of information between DOE, Hanford Site contractors, and stakeholders; and (3) decision-making that is supported by technically sound information and realistic expectations for success. A fundamental value that underlies most concerns is credibility in all aspects of DOE's stewardship at the Hanford Site.

With these concerns and values in mind, the following mission statement has been adopted:

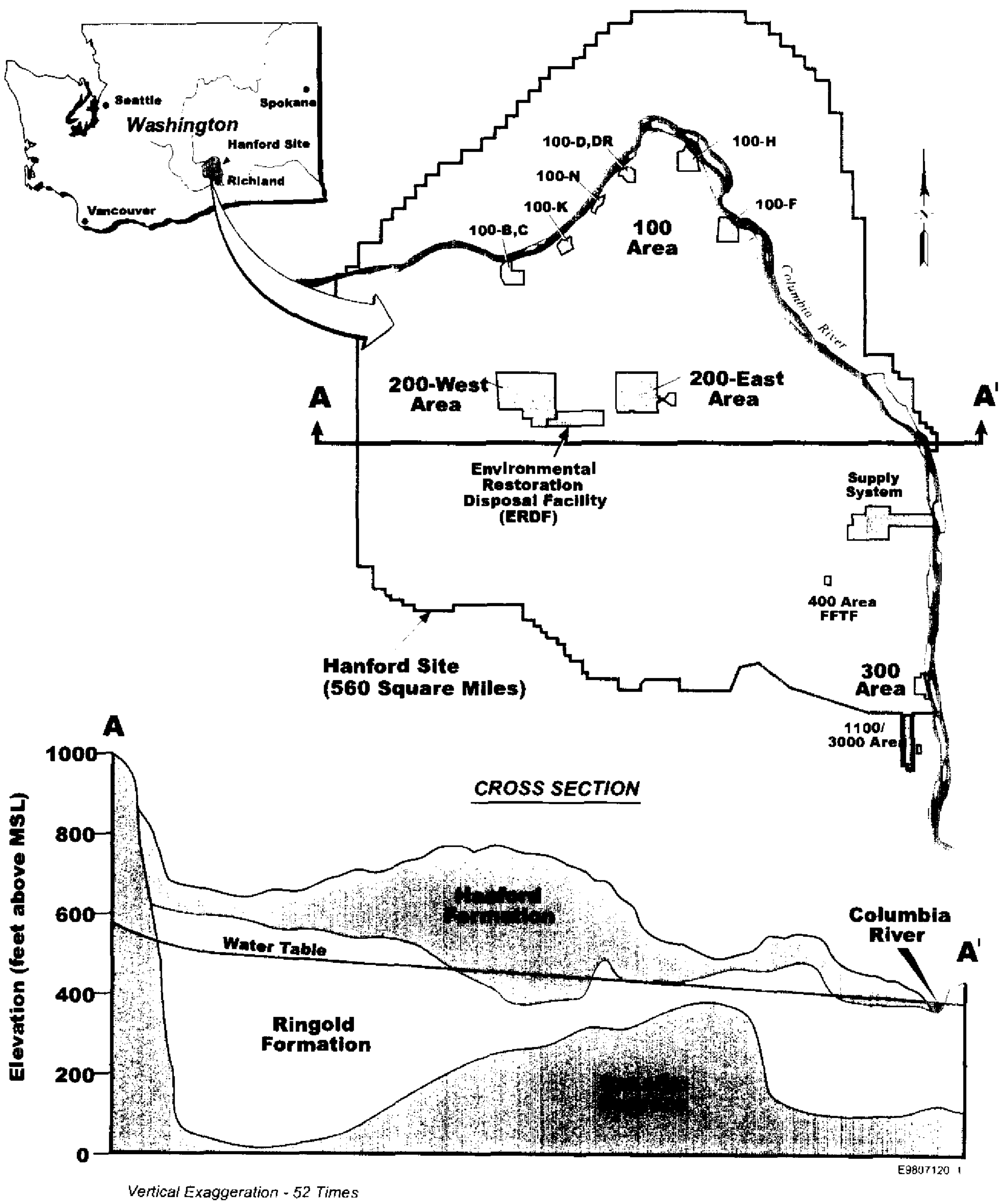
The mission of the Groundwater/Vadose Zone Integration Project is to ensure that Hanford Site decisions are defensible and possess an integrated perspective for the protection of water resources, the Columbia River environment, river-dependent life, and users of Columbia River resources.

1.3 CHALLENGES

The Hanford Site is located in a large tract of desert land referred to geographically as the Pasco Basin. The principal features and facilities of the Hanford Site are shown in Figure 1-1. The arid climate and isolated character of the region made it a particularly attractive site for World War II plutonium production activities, which subsequently continued during the Cold War. These activities left a legacy of large volumes of wastes that include toxic chemicals and radioactive substances. Some of these wastes were intentionally (or otherwise) introduced to the vadose zone, the groundwater, and the Columbia River.

The Integration Project is concerned with natural systems, which include the vadose zone, groundwater, and the adjacent Columbia River. The Integration Project is also concerned with hazardous wastes from Hanford Site operations that have entered, or have the potential to enter these natural systems. A diagram that highlights some of the major features of these systems, as viewed by the Integration Project, is presented in Figure 1-2. The components of the natural systems and the various man-made features and activities that affect them are collectively referred to as a conceptual model for the system.

Figure 1-1. Principal Features and Facilities at the Hanford Site.



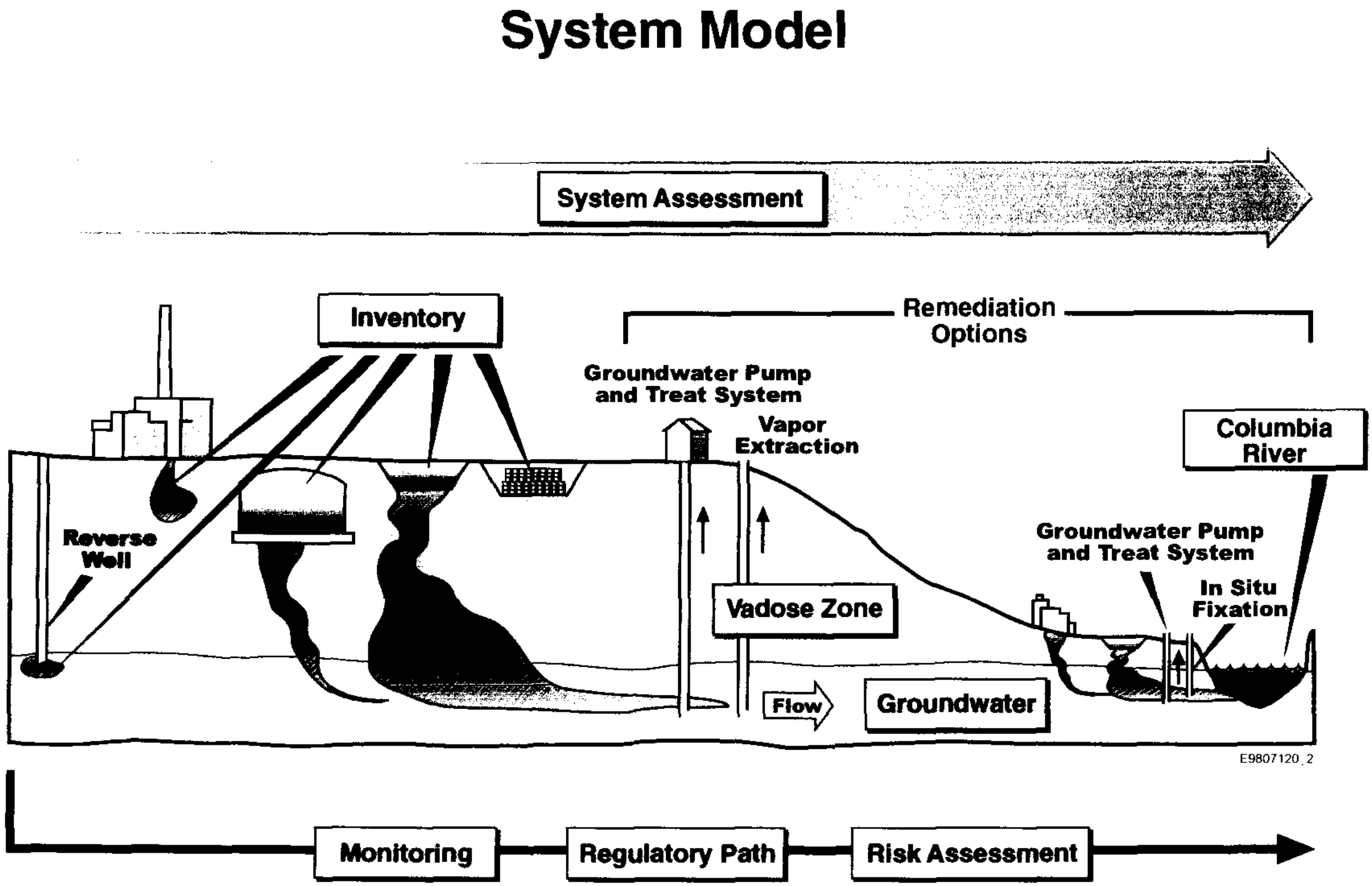


Figure 1-2. System Model.

Given the general conceptual model for the system, numerous challenges are recognized. Principal among the challenges are the following:

- Generate a credible system model.
- Infuse new science and technology into addressing the cleanup.
- Effectively integrate and manage the work scope associated with the project.
- Accommodate meaningful stakeholder involvement.
- Perform work scope under constraints imposed by public law and legally-binding agreements.

A practical aspect of the final constraint listed above is that the *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement)* defines remedial action activities.

1.4 THE PROJECT SPECIFICATION

The *Project Specification* defines and communicates the vision, mission, goals, objectives, and technical boundaries for the scope of work needed to achieve project objectives. The *Project Specification* also fulfills selected requirements for a *Groundwater Protection Management Plan* (GPMP), as identified in DOE Order 5400.1 *(Environmental Protection Program)*. Appendix A shows how the requirements of a GPMP are accommodated by the Integration Project documentation.

The *Project Specification* is prepared in accordance with DOE's established approach for managing the RL Environmental Restoration (ER) Program. The *Project Specification* is the first in a series of documents that form the planning and management baseline for the Integration Project. The document hierarchy for project is shown in Figure 1-3.

The content of each baseline document is briefly described in the following paragraphs.

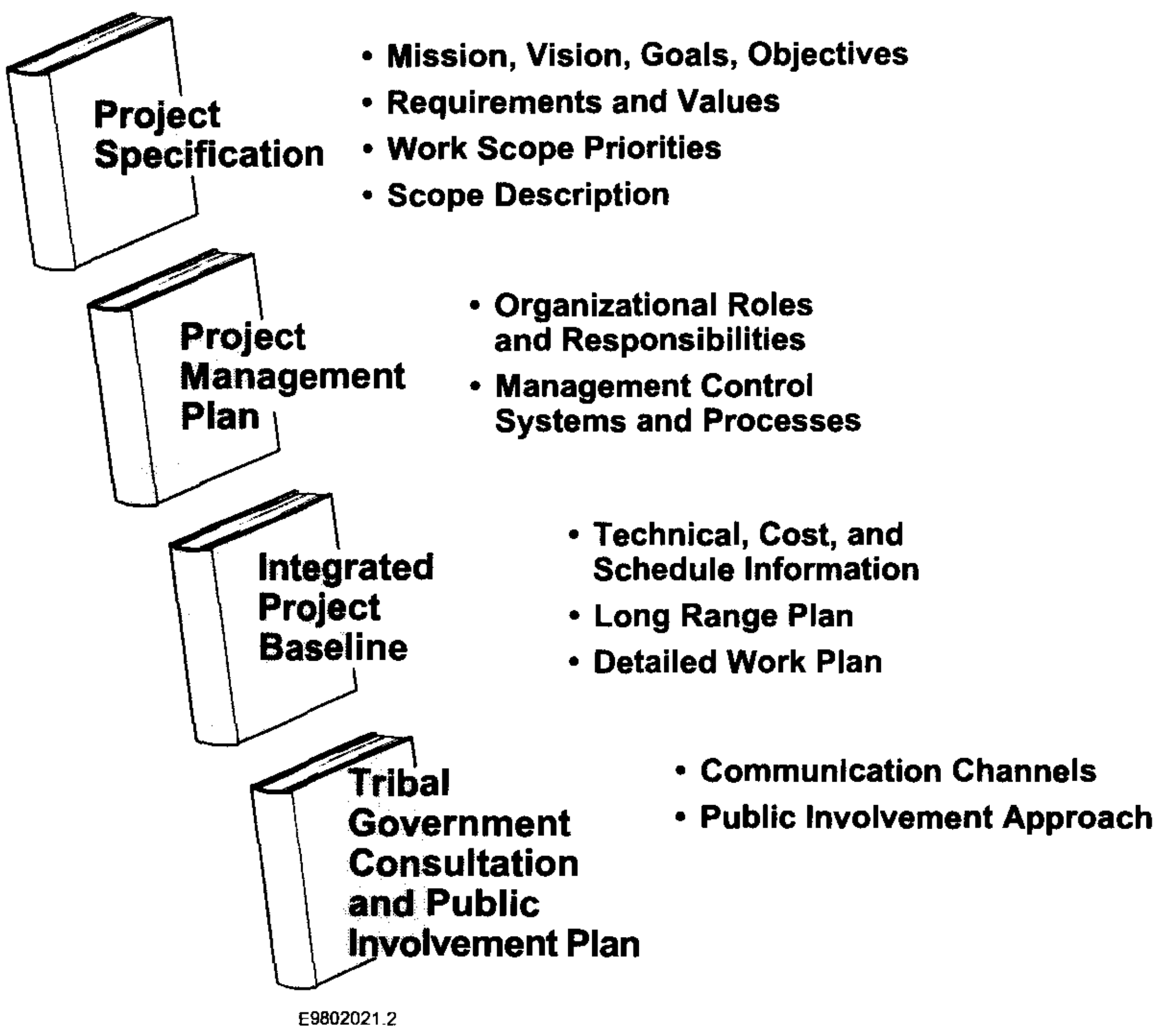
1.4.1 Project Specification

The *Project Specification* is a strategic level document that defines and describes the technical scope of the Integration Project. The *Project Specification* identifies Hanford Site activities affecting subsurface and river contamination and transport, as well as protection of Hanford Site groundwater resources and the Columbia River. Sources of information used in defining the *Project Specification* scope include published reports and studies, issues and recommendations, interviews (internal and external to the Hanford Site), existing technical baselines, physical boundaries of the soil, groundwater, and river systems, and current strategies and decision documents.

1.4.2 Project Management Plan (PMP)

The PMP defines the overall management of the technical scope, cost, and schedule baselines for the Integration Project. The plan defines the authorities, organizational roles, and responsibilities

Figure 1-3. Integration Project Document Hierarchy.



of Integration Project participants, as well as the application of control systems for directing work, reporting progress, and making changes. A disciplined systems engineering approach for correlating systems, activities, and organizations that are associated with the project mission is emphasized within the PMP. A graded approach is used in applying requirements relative to the complexity and budgeted value of the elements that are managed within the Integration Project.

1.4.3 Integrated Project Baseline

The *Integrated Project Baseline* identifies the processes, tools, and resources required to develop and maintain the Integration Project cost, schedule, and technical scope of work. These resources include the prioritization logic, the *Schedule Baseline/Long Range Plan* (LRP), and the cost baseline.

The primary objective of the baseline development effort is to identify the actions necessary to define the Integration Project scope, cost, and schedule, and to assign responsibility for these elements. Baseline management involves those actions required to ensure adequate project control and maintenance, and provides the benchmark for subsequent evaluations of project performance.

The Integration Project baseline evolves from initial definition of technical requirements, cost estimates, and schedule milestones through development of detailed plans. In addition, the baseline is influenced by regulatory constraints, funding guidance, revisions in RL direction, and active participation of the Tribal Nations and stakeholders. Changes will be incorporated into the baseline through standard change control processes.

1.4.4 Tribal Government Consultation and Public Involvement Plan

The *Tribal Government Consultation and Public Involvement Plan* solicits active participation in devising effective methods of public involvement, as well as identification of communication issues. The plan serves as a starting point for the development of an interactive approach for *Tri-Party Agreement* agencies to seek the involvement and advice of Tribal Nations and stakeholders for consideration in major Integration Project documents and decisions.

The objective of the *Tribal Government Consultation and Public Involvement Plan* is to enable project participation and involvement by all interested parties. The plan has the following four goals:

- Provide interested audiences with timely and accurate information.

- Actively encourage effective dialogue with interested audiences to assist project decision-makers.

- Provide for various levels of involvement in the project, while encouraging in-depth issue involvement.

- Provide outreach opportunities for Pacific Northwest communities to inform the public of the project and provide awareness of ways to participate.

1.5 ORGANIZATION OF THE PROJECT SPECIFICATION

This project specification is organized as follows:

Section 1.0 - Introduction. This section describes the purpose and scope of the document, and provides background information about the establishment of the Integration Project. This section also identifies the primary Integration Project documents, and the relationships between these documents.

Section 2.0 - Requirements, Values, and Recommendations. This section identifies applicable federal, state, and local laws and regulations; DOE orders; legal agreements; Tribal Nations, stakeholder, and public values; and issues/recommendations developed by external organizations to provide a controlling framework for the Integration Project scope.

Section 3.0 - Project Goals, Objectives, and Strategy. This section summarizes the Integration Project goals, objectives, and strategy.

Section 4.0 - Project Technical Elements. This section describes the technical scope of each project element.

Section 5.0 - Project Approach. This section summarizes the general approach, process, and organizing principles that will be used by the Integration Project.

Section 6.0 - Process for Determining Work Priorities. This section identifies the means by which criteria will be identified and applied to define the priorities of the Integration Project work scope.

Appendix A - Matrix Comparison of Project Documents to Groundwater Protection Management Plan (GPMP) Requirements. This appendix identifies the locations in project documentation where GPMP requirements are addressed.

Appendix B - Pertinent Federal and State Laws and Regulations. This is a summary listing of all laws and regulations applicable to those Hanford Site activities within the technical scope of the Integration Project.

Appendix C - Summary of External Reviews and Recommendations. This appendix lists reviews and recommendations from organizations and individuals external to the Hanford Site regarding activities that fall within the technical scope of the Integration Project.

Appendix D - Current and Future Expectations. This appendix contains brief summaries of projects on the Hanford Site performing work within the purview of the Integration Project.

Appendix E - Applicable CRCIA Requirements and Guidelines. This appendix summarizes the requirements and guidelines from Part II of the *Screening Assessment and Requirements for Comprehensive Assessments: Columbia River Comprehensive Impact Assessment* (CRCIA: DOE/RL-96-16, Rev. 1, 1998), which are applicable to the scope of the Integration Project.

2.0 REQUIREMENTS, VALUES, AND RECOMMENDATIONS

Integration Project activities are driven by public laws, congressional mandates, agreements between federal and state agencies, public values, and public recommendations. A principal challenge for the Integration Project is to balance requirements, values, and recommendations with budgetary constraints and the efficient use of available resources. A process for determining work priorities is described in Section 6.0, which identifies the importance of these factors in the development of decisional criteria.

The following sections summarize (1) principal legal requirements for the project; (2) stakeholder values; and (3) recommendations from agencies, organizations, and stakeholders.

2.1 REQUIREMENTS

Federal agencies, including DOE, are required by executive order to comply with federal, state, and local laws and regulations. DOE implements this executive order through DOE Order 5480.4, which requires compliance with these laws and regulations, and DOE Order 5400.1, which describes federal laws and executive orders. The principal federal laws that pertain to the Hanford Site and the environment include the following:

- *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*
- *Resource Conservation and Recovery Act (RCRA)*
- *Emergency Planning and Community Right-to-Know Act*
- *Atomic Energy Act (AEA)*
- *Clean Air Act*
- *Clean Water Act*
- *Safe Drinking Water Act*
- *Toxic Substance Control Act*
- *Federal Insecticide, Fungicide, and Rodenticide Act*
- *Endangered Species Act*
- *National Historic Preservation Act*
- *Archaeological Resources Protection Act*
- *Native American Graves Protection and Repatriation Act*
- *American Indian Religious Freedom Act*
- *National Environmental Policy Act*

In addition, there are many state laws and site-specific agreements that pertain to the Hanford Site and the environment. These include the following:

- *Washington Hazardous Waste Management Act*
- *Model Toxics Control Act*
- *Washington Surface Water Quality Standards*

- *Washington Groundwater Quality Standards*
- *Tri-Party Agreement*
- *Hanford Facility RCRA Permit*

Many regulations under federal laws are delegated to the states for implementation. Washington State implements federal regulations through the following regulations and laws:

- *State of Washington Dangerous Waste Regulations,* which implement RCRA for treatment, storage, and disposal facilities.

- *State of Washington Model Toxics Control Act,* which implements the state environmental cleanup program, including the establishment of cleanup standards at RCRA units.

- *State of Washington Surface Water Quality Standards,* which establish criteria in accordance with the federal *Clean Water Act.*

A comprehensive listing of federal, state, and local laws and regulations that are relevant to the Integration Project is provided in Appendix B. Within Appendix B, Table B-1 presents federal laws and regulations, and DOE orders. Table B-2 presents state laws and regulations.

Several site-specific, legally-binding agreements detail how various key laws and regulations will be implemented at the Hanford Site. Among these are the *Tri-Party Agreement,* which is the primary working agreement between U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and DOE regarding environmental restoration at the Hanford Site, and the Hanford Facility RCRA permit.

2.2 VALUES

Values associated with Hanford Site contamination and its impact on the vadose zone, groundwater, and Columbia River have been expressed several ways. The diverse groups that have expressed their values include the Tribal Nations, advisory boards, public interest groups, and the regulatory community.

Recent Interviews with Stakeholders. As part of the early planning associated with the Integration Project, groups and individuals who have shown a strong interest in the project were interviewed. Values and expectations expressed in these interviews included the following:

- Protect the Columbia River from further contamination to the maximum extent possible.

- Integrate activities to ensure a holistic approach to Hanford Site cleanup.

- Address all sources of contamination.

- Minimize further contamination of the groundwater and vadose zone.

- Develop adequate models for vadose zone contamination and contaminant transport mechanisms.
- Conduct independent expert and independent technical peer reviews.

Regulatory Agencies. Values expressed by regulatory agencies are documented in records-of-decision (RODs) associated with remedial actions, and in permits for treatment, storage, and disposal (TSD) facilities. Remedial actions must be designed such that their implementation does not result in a new threat to human health and the environment. An underlying value common to all regulatory agencies is that cleanup decisions, remedial actions, and operating facilities must comply with federal/state law and implementing regulations. For example, CERCLA requires that groundwater remedial actions currently in progress at several reactor areas along the Columbia River protect human health and the environment. More specific values are expressed in the objectives for proposed remedial actions. Likewise, under RCRA regulations to protect the environment, the monitoring associated with a permitted facility must be capable of detecting new contamination or assessing known contamination.

RODs also contain a "Responsiveness Summary" appendix. This summary contains public comment and agency responses to issues raised during the public review and comment period for proposed actions. The value of protecting the Columbia River from degradation as the result of contaminants from the Hanford Site is prominent in these comments.

Advisory Boards. The Hanford Advisory Board (HAB) is composed of representatives from state agencies, Tribal Nations, public interest groups, and employees at the Hanford Site. Specific values and principles expressed by the HAB include the following:

- Protect the Columbia River ecosystem.
- Deal realistically and forcefully with groundwater contamination.
- Use a systems design approach that keeps endpoints in mind as interim decisions are made.
- Recognize the importance of cultural, ecological diversity, and recreational opportunities; enhance these opportunities as a result of cleanup and waste management decisions.
- Consider these concerns while promoting the most effective and efficient actions that will protect the environment, public health, and safety -- now and for future generations.

Tribal Nations' Values. Several Tribal Nations and the Wanapum people have provided RL with comments on Hanford Site activities. The Tribal Nations include the Confederated Tribes and Bands of the Yakama Indian Nation (YIN), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and the Nez Perce Tribe (NPT). A value common to all the Tribes is protection of the Columbia River's natural resources, which are used by tribal members for sustenance and in their traditional culture. Of special value is protection of the salmon fishery.

For those tribes that used the Pasco Basin in earlier times, protection of cultural resources along the river banks is highly important. An underlying value for each Tribal Nation is the opportunity to participate in selecting remediation alternatives and designing environmental restoration projects.

Recent correspondence from the YIN emphasizes that new programs, like the Integration Project, should be developed by using the experience gained through such previous programs as the CRCIA. A central value of the CRCIA is that assessment of impacts on the Columbia River that are related to Hanford Site contamination will be conducted in a holistic manner. The CRCIA assessment plan emphasized a broad, overarching analysis that spans Hanford Site contaminant sources, contaminant pathways to the river, sensitive receptors, and receptor impacts. The analysis must consider (1) a time scale that extends well into the future; and (2) impacts to natural and cultural resources.

The CTUIR provided a comprehensive statement of their values in a 1993 letter that commented on the initial plans for a comprehensive river impact evaluation:

"From salmon and sturgeon to tule reeds and eagle feathers, the ecosystem provides the very fabric of tribal culture. Any impact evaluation that considers the Columbia River environment should assist the CTUIR in understanding and evaluating the magnitude and future consequences of adverse impacts on natural resources."

The statement adds that *"cleanup of contamination is conducted in a manner that optimizes sustained net flow of tribal benefit through the conservation, management, and utilization of fish, wildlife, plant, and cultural resources, while protecting the integrity, sustainability, and diversity of the natural ecosystem."*

Correspondence from the NPT reinforces values expressed by other tribes concerning protection of Columbia River resources from degradation caused by Hanford Site contaminants. The NPT emphasize that *"Tribal consultation, on future Hanford Site land use (which) directly impacts our most important resource, the Columbia River, is of utmost concern to the Nez Perce People."*

Public Interest Groups. Several public interest groups actively provide input to Hanford Site activities. A common value expressed by these groups involves the responsible use of public funds to address contamination and waste management issues at the Hanford Site. Some public interest groups actively supported scientific investigations to better define contamination characteristics along the Hanford Site shoreline, in order to provide a technical basis for cleanup decisions. An important value to many public interest groups is that the public be an active participant in Hanford Site decisions, particularly the public living along the river downstream of the Hanford Site.

2.3 RECOMMENDATIONS

Much of the external oversight of the Hanford Site during the past 10 years has involved issues associated with the tank farms. Leakage from the tanks has occurred, and evidence suggests that leakage has migrated to groundwater. Travel times to the river from the 200 East Area are sufficiently short to raise concerns regarding future adverse impacts to the river's ecosystem. This has resulted in increased oversight of the tank farm operations. Other areas that have been addressed through external oversight include the Hanford Site's impact on the Columbia River.

2.3.1 External Oversight Associated with Tank Farms

During the early planning stages for the Integration Project, a review of documents and correspondence was made to summarize major issues and recommendations concerning contamination in the vadose zone and groundwater beneath the tank farms, as viewed by outside organizations. The review included comments from the following organizations and stakeholders:

- National Academy of Sciences
- General Accounting Office
- Expert Panels *(chartered by DOE, Congress, etc.)*
- Hanford Advisory Board
- State and Local Regulatory Agencies
- Indian Nations *(YIN, CTUIR, and NPT)*
- Special Interests Groups *(Hanford Environmental Action League [HEAL], Columbia River United [CRU], etc.)*

Direct quotes from each document or piece of correspondence were entered into an electronic database, so that subsets of various topics and reviewing organizations could be made using keyword searches. The issues and recommendations that are currently in the database are reproduced in Appendix C. Although numerous issues and recommendations were discovered that related to the tank farms in general, a relatively small subset is directed at the vadose zone and groundwater. The following is a synopsis of these recurring issues:

- Significant uncertainties exist regarding the composition, concentration, and distribution of tank leakage in the soil column beneath the tank farms, and this limits the credibility of tank remediation decisions and environmental risk assessments.

- Organizational complexities and vested interests are barriers to solving difficult engineering and scientific problems associated with the tank farms. However, solving the engineering and scientific problems is not an insurmountable problem.

- The scope, schedule, and budget constraints imposed by the *Tri-Party Agreement* are frequently viewed as unrealistic, with an inadequate technical basis. Rigid adherence to these constraints is a hindrance to progress in solving tank farm technical problems.

- DOE is not providing effective management of tank farm cleanup activities.

External reviewers frequently offered recommendations on how to address the issues that were identified. A synopsis of many of the recommendations follows:

- Uncertainties in available information can be reduced through (1) improved monitoring of conditions outside the tanks; (2) improved characterization of vadose zone stratigraphy (e.g., lithology and structures in sediments); and (3) improved understanding of how contamination moves in the vadose zone sediments.

- The tank farm project could benefit from new approaches and ideas for solving its variety of technical problems, including environmental contamination. Solutions might include (1) a revised project organizational structure; (2) more frequent independent peer reviews; (3) open competition for performance of key tasks; and (4) better communication with the public.

- A phased approach to final disposition of the tank farms is recommended, proceeding from accurate characterization of the wastes inside and outside the tanks, so as to understand how leaked contamination moves through the vadose zone, and to describe risks posed by the contamination that reaches the water table and is distributed through groundwater movement. Engineering solutions to tank waste removal and/or stabilization should proceed in parallel with characterization activities.

2.3.2 Recommendations from the CRCIA Team

The stated purpose of the CRCIA is to assess the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-dependent life, and users of river resources for as long as these contaminants are hazardous.

The CRCIA prepared an extensive list of requirements for inclusion in any Hanford Site assessment activity. These requirements reflect a much broader view of the Hanford Site's impact on the Columbia River than was previously available. Recommendations recently offered by the CRCIA team are outlined below:

- Decisions affecting waste isolation must consider and encompass (1) cumulative site-wide effects on the region; (2) uncertainty in the estimated effects; and (3) needed safety margins for disposal solutions, to offset uncertainties.

- Hanford Site endstates must be defined to (1) understand source of effects; and (2) provide descriptions for review by potentially affected people.

- Key decisions should be evaluated for Columbia River and regional impacts, including (1) shipment of offsite wastes to the Hanford Site; (2) the planned endstate for the 200 Area; (3) tank waste retrieval and storage; (4) the planned endstate for the burial grounds; and (5) containment performance of liners and subsurface barriers.

- Independent direction of the assessment's performing contractor is essential to acceptable results. It is common practice for the evaluator to be independent of the agent performing the work. The concept is consistent with DOE Headquarters' (HQ) independent project review process.

3.0 PROJECT GOALS, OBJECTIVES, AND STRATEGY

In order to perform the Integration Project mission, and achieve the project vision, the goals that the Integration Project works toward must address a wide spectrum of scope that includes the sources of Hanford Site contamination, movement of contaminants through the physical system, and ultimately the interaction of contaminants with receptors. At this point in time, the most comprehensive set of goals that address the majority of the Integration Project's scope is defined in the *Hanford Strategic Plan* (DOE 1996). The goals of the *Strategic Plan* are summarized in this section, as well as the applicability of each goal to the Integration Project. As the Integration Project evolves, this set of goals may become inadequate to address the entire scope of the project. Additional goals will then be incorporated into this document, as they are approved.

A set of project-specific objectives is also included in this section. The objectives were developed through a series of public involvement workshops.

3.1 GOALS

Goals and the major actions identified to accomplish the *Hanford Strategic Plan* (DOE 1996) are identified in Table 3-1. The goals and actions are grouped by geographic area and material type, and the relationship of each to Integration Project technical elements is identified. The concept of the technical elements is more fully explained in Sections 3.3 and 4.0. The actions that are identified in the table include both the ultimate (or "final") and more immediate (or "interim") targets. Final actions involve long-term desired outcomes. Interim actions are feasible, positive steps that assure progress toward final objectives. Actions describe those things that must be done to accomplish the project's mission, independent of changes to organizational structure and funding. The Columbia River actions are not defined in detail. As these details are defined they will be incorporated into this *Project Specification.*

3.2 OBJECTIVES

The objectives of the Integration Project are as follows:

- Coordinate and align technical work towards common goals that result in protection of water resources.
- Develop assessment methods for human health and ecological risk that support all cleanup decisions.
- Evaluate the sustainability of groundwater resources and the river ecosystem, the cultural quality of life, and socioeconomic impacts over the period of time that Hanford-derived contaminants remain intrinsically hazardous.

- Instill a sound technical basis for Hanford Site cleanup decisions through the use of applied science and technology.
- Provide a means for making sound and consistent management decisions throughout all affected Hanford Site programs.
- Be open and responsive to the regulators, stakeholders, the public, and Tribal Nations.

3.3 STRATEGY

Seven tenets form the foundation of the Integration Project's approach to achieving the Integration Project's mission and objectives. These tenets form the basis for planning, coordinating, integrating, and executing work. The tenets are as follows:

Activity Integration. The Integration Project views work from the perspective of technical information or capability needs, rather than from a viewpoint constrained by the scope and objectives of individual projects. All work is evaluated by grouping activities along technical lines or technical elements. Knowledge gaps, overlapping work scope, and project inefficiencies are assessed in this evaluation process. A more complete discussion of Integration Project technical elements is contained in Section 4.0. A general discussion of the project approach to integration is provided in Section 5.0.

Work Control. To ensure that technical products used in decision-making are adequate, the Integration Project has technical review-and-approval authority over all work scope within the technical element descriptions provided in Section 4.0. In addition, the Integration Project advises RL in regulatory matters affecting the Integration Project. In an advisory capacity, the Integration Project participates in all regulatory discussions regarding technical work scope within the scope of the technical elements.

Decisional Timeframes. Work activities that are within the scope of the Integration Project commonly are performed in response to requirements (e.g. public laws or legally-binding agreements), controls, and constraints. Each activity has a completion schedule that is dependent on the timeframe in which decisions must be made. The Integration Project groups activities into three timeframes: short-term (e.g., potential impacts at the edge of the Columbia River); intermediate-term (e.g., leaking tanks in the Central Plateau); and long-term (e.g., an assessment of the potential for future impacts from Hanford Site contamination). Near- and intermediate-term activities have many more constraints than long-term activities, and are generally captured within ongoing projects. Long-term activities are described in the overall Hanford Site system assessment capability. The Integration Project will honor the constraints imposed on near- and intermediate-term work, and will develop a long-term concept of common or shared goals. This concept is further developed in Section 5.9.

Applied Science. The Integration Project provides the focal point for accessing appropriate technical resources to help identify and resolve key technical issues, or to develop critical technical capabilities. The Integration Project will maintain national laboratory involvement in project activities. Other offsite technical resources will be brought to bear on issues as appropriate.

Review Process. The Integration Project sponsors and supports a multi-level review process to help foster trust and confidence in the planning, execution, and reporting of technical materials, through a multi-level review process. Technical issues, work scope, recommendations, and products are all subject to review by organizations that are external to the project.

Work Priorities. Work that is identified by the Integration Project will be evaluated against a set of criteria in order to assign priorities. The process to determine the criteria and assign priorities is implemented to ensure that appropriate work is performed at the right time, and that this work represents a proper expenditure of public funds. A discussion of the process is presented in Section 6.0.

Open Process. The Integration Project is committed to open communication, active participation, and a free exchange of information and ideas during the conduct of project work. All information and ideas will be considered during planning and decision-making activities. The Integration Project's position with regard to an open process is defined in the *Tribal Government Consultation and Public Involvement Plan*.

Table 3.1 Hanford Site Goals and Actions Related to Integration Project Technical Elements

Integration Project Technical Element	Material Category	Reactors on the River Area	Central Plateau Area	South 600 Area	Central Core Area	Columbia River Area
		Reactors on the River Goal: Remove and/or stabilize spent fuel, surplus facilities, and waste sites to protect groundwater and the Columbia River, and to ensure protection of people, the environment, and natural/cultural resources. Pending Congressional action on the Wild and Scenic River designation, use will continue to be restricted. Sensitive ecological, cultural, and Native American resources will be protected.	**Central Plateau Goal:** The 200 Areas and Central Plateau will be used for the management of nuclear materials, for the collection and disposal of waste materials that remain onsite, and for other related and compatible uses. Cleanup levels and disposal standards will be established that are consistent with these long-term uses.	**South 600 Area Goal:** The 300 Area waste sites, materials, and facilities will be remediated to allow industrial and economic diversification opportunities. The federal government will retain ownership of land in and adjacent to the 300 and 400 Areas, but will lease land for private and public uses to support regional industrial and economic development. Excess land within the 1100 area will be targeted for transition to non-federal ownership.	**Central Core Goal:** This area will remain in federal ownership, consistent with safety analysis boundaries and continued waste management operations in the 200 Area. These areas will be available for other federal programs, or leased for non-federal uses, consistent with appropriate recognition of cultural and ecosystem values.	**Columbia River Goal:** Pending congressional action on the Wild and Scenic River designation, use will continue to be restricted; sensitive ecological, cultural, and native American resources will be protected. (The Columbia River area is not carried through the endpoint table because it contains a unique set of material categories that must be addressed).
Inventory Related	**Spent Fuel Goal:** Spent nuclear fuels will be prepared and packaged, as necessary, for interim, dry-storage onsite, and shipped offsite for disposal in a national repository.	• Spent fuel will be removed and the K-Basins cleaned sufficient to transition to D&D.	• *Spent fuels consolidated in the 200 Area in safe, stable, cost-effective interim storage pending national decisions on their ultimate disposition.* • Spent fuels removed offsite for final disposition.	• *Spent fuels (light water reactor) will be removed to interim storage in the 400 Area pending availability of 200 Area interim storage.* • Spent fuels (TRIGA and light water reactor) and applicable FFTF fuels will be removed from the 400 interim storage area to the 200 Area. • Spent fuels (sodium-bonded EBR-II test assemblies) will be removed offsite for final disposition.		
Inventory Related	**Facilities Transition Goal:** Safe, stable, and secure onsite storage will be provided for all nuclear materials, pending decisions on final disposition, or until beneficial offsite uses are identified. Facilities without identified future uses will be transitioned to low-cost, stable deactivated conditions (requiring minimal surveillance), pending eventual D&D and removal or closure.	*Drain, decontaminate, and stabilize the K-Basins facility.*	• *Transition high-cost surplus facilities to a low-cost, stable, deactivated condition.* • *Provide safe, stable, interim storage for nuclear materials in the 200 Area pending decisions on their ultimate disposition.* • *Continue to provide safe storage for Cs/Sr capsules in the WESF indefinitely. Make WESF a decoupled and a stand-alone facility.* • *Transition the PUREX facility and B Plant to a low-cost, stable deactivated condition.* • *Complete stabilization of plutonium in PFP to a low cost, stable, deactivated condition.* • *Complete stabilization of plutonium in PFP.* • *Transition production areas of PFP to a low cost, stable, deactivated condition; continue safe, stable, interim storage of plutonium.*	• *Transition high-cost surplus facilities to a low-cost, stable deactivated condition.* • *Remove uranium through interim storage in the 400 Area.* • *Transition the FFTF to a low-cost, stable deactivated condition.* • *Complete transition of the 300 Area Fuels Supply.* • *Transition the 324/327 buildings to a low-cost, stable deactivated condition and disposition their nuclear materials (including 324 building radioactive tank wastes).* • *Complete deactivation of the Nuclear Energy Legacy facilities.* • *Transfer Special Nuclear Material to 200 Area for interim storage.* • *Complete final disposition of remaining unirradiated uranium inventories by disposition offsite or disposal as LLW in the 200 Area.*		

NOTE: Interim endstates are presented in italicized type.
Final endstates are presented in regular type.

Table 3.1 Hanford Site Goals and Actions Related to Integration Project Technical Elements

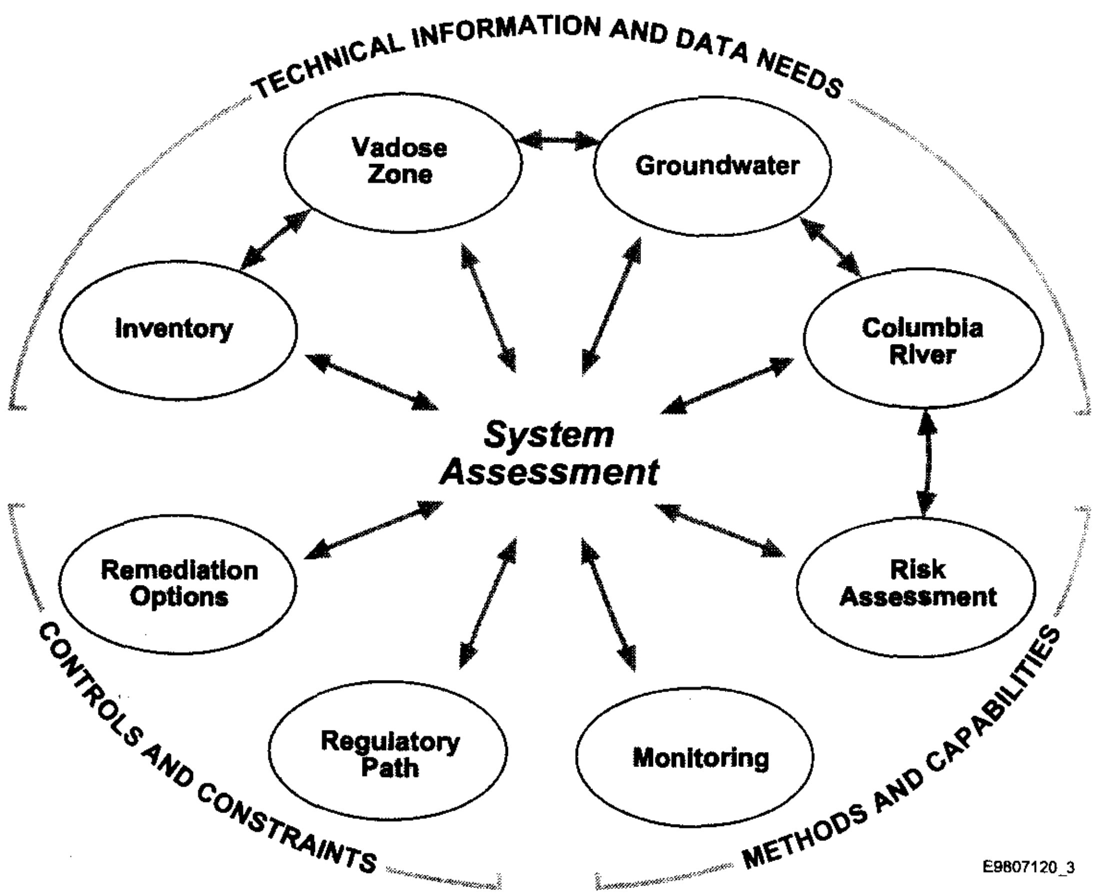
Integration Project Technical Element	Material Category	Reactors on the River Area	Central Plateau Area	South 600 Area	Central Core Area	Columbia River Area
Inventory Related	**Facilities D&D Goal:** Surplus facilities will be decommissioned and decontaminated sufficiently to enable removal or closure through entombment.	• *Reactors will be placed in interim safe storage pending future removal.* • Reactor blocks will be transported to the Central Plateau following ~75 year waiting period to allow natural decay of existing radiation levels. • Remove non-essential, surplus buildings and facilities that do not have identified post-cleanup uses.	• Dismantle, or close through entombment, D&D facilities currently assigned to the ER program. • Remove non-essential surplus buildings and facilities that do not have identified post-cleanup uses.	• Reuse facilities for economic diversification, where feasible. • Remove non-essential surplus buildings and facilities that do not have identified post-cleanup uses.	• Remove non-essential, surplus buildings and facilities that do not have identified post-cleanup uses.	
Inventory Related	**Solid Waste Goal:** Solid waste will be dispositioned consistent with national policies for management of transuranic, low-level, low-level mixed, and hazardous wastes. Hanford will continue to receive onsite and offsite wastes for disposal in the 200 Area.		• Retrievable stored TRU waste will be retrieved, processed, and shipped offsite to the WIPP. • Low-level and low-level mixed waste from onsite and offsite sources (including PNNL special case wastes) will continue to be disposed in the 200 Area.			
Inventory Related	**Radioactive Tank Waste Goal:** Tank waste from both SSTs and DSTs will be retrieved for immobilization. Waste will be separated into high-level and low-activity fractions. LLW will be immobilized and disposed onsite. HLW will be immobilized for disposal in an offsite federal repository.		• *Retrieve tank wastes to the extent needed for tank closure; divide into high-level and low-activity fractions; immobilize.* • The immobilized low-activity fraction will be disposed onsite in a 200 Area disposal system. • The high-level immobilized fraction will be interim stored until it can be shipped offsite for disposal (this is planned for the Yucca Mountain geologic repository). • For Cs/Sr capsules declared as waste, send to Yucca Mountain for HLW repository disposal. • After the waste has been retrieved from the tanks, the tank farms-including the tanks-will be closed.			
Vadose Zone Related	**Soil Sites Goal:** Contaminated soil sites will be treated to levels supportive of future use targets of regulator-specified levels for each geographic area, as prescribed by CERCLA/RCRA decisions.	• Soil sites will be remediated consistent with ROD cleanup standards. • Final cleanup levels will be established within individual RODs or permit modifications.	• Soil sites will be closed in place with surface barriers, or remedial alternatives will be established within individual RODs or permit modifications. • Operate the ERDF to accept waste from remediation of CERCLA units across the Hanford Site.	• Soil sites will be remediated consistent with ROD cleanup standards. Contaminated media will be consolidated and moved to the 200 Area for disposal. • Final cleanup levels will be established within individual RODs or permit modifications.	• Final cleanup levels will be established within individual RODs or permit modifications.	
Groundwater Related	**Groundwater Goal:** Groundwater remains restricted for a yet to be determined period, pending decisions on final attainable cleanup levels. Remediation actions will protect the Columbia River and the near-shore environment; reduce contamination entering the groundwater; and control the migration of plumes that threaten groundwater quality beyond the boundaries of the Central Plateau.	• *Groundwater use remains restricted for a yet to be determined period; groundwater will be intercepted or contained to protect the Columbia River and the environment.* • Final cleanup levels will be established within individual RODs or permit modifications.	• *Groundwater use remains restricted for a yet to be determined period; groundwater will be intercepted or contained to within designated boundaries.* • Final cleanup levels will be established within individual RODs or permit modifications	• *Groundwater use remains restricted for a yet to be determined period; existing site plumes will continue to be monitored.* • Final cleanup levels will be established within individual RODs or permit modifications.	• *Monitor existing groundwater site plumes; intercept or contain as necessary to protect the Columbia River.* • Groundwater use remains restricted for a yet to be determined period.	

NOTE: Interim endstates are presented in italicized type.
Final endstates are presented in regular type.

4.0 PROJECT TECHNICAL ELEMENTS

Four types of work scope are part of the overall Integration Project: (1) technical information and data needs; (2) methods and capabilities; (3) controls and constraints; and (4) integration. These categories are further subdivided into technical elements, as illustrated in Figure 4-1. The independent pertinence of some elements, particularly for controls and constraints, depends on the urgency of the decisions supported by the work. The work scope for these technical elements was defined with the assistance of stakeholders, through public workshops.

Figure 4-1. Integration Project Technical Elements.



Technical Information and Data Needs. This category contains the *Inventory, Vadose Zone, Groundwater,* and *Columbia River* technical elements. Work scope associated with these elements involves characterization of various features and processes essential to development of conceptual models of how the natural system works. The term "information" includes interpretations of field observations and the output from numerical analyses.

Methods and Capabilities. The *Monitoring* and *Risk Assessment* technical elements are included in this category. These contribute to the information and data needs technical elements. Work scope within *Monitoring* pertains to data collection methods and logistics. *Risk Assessment* activities pertain to using various accepted methods, or developing new methods, to quantify risk to human health and the environment for various scenarios.

Controls and Constraints. This category describes the *Regulatory Path* (regulations and legally binding agreements) and *Remediation Options* (technological options available for mitigation and/or remediation). These elements form the principal basis for the project's technical work scope.

Integration. The elements described above are integrated within the *System Assessment* technical work element. The work scope of this element consists of the iterative aspects of evaluating information relative to project objectives, and redefining or identifying additional work scope, as appropriate.

4.1 INVENTORY

Inventory is the total quantity of radiological and chemical constituents used and created at the Hanford Site, and their distribution in facilities, waste disposal sites, the vadose zone, groundwater, and Columbia River ecosystem. Information needs associated with inventory include (1) locations, amounts, and concentrations; (2) characteristics of the radionuclide or chemical compound; (3) mobilization and release mechanisms and rates; and (4) the change in inventory because of natural processes (e.g., decay), remediation activities, and Hanford Site operations.

In addition to inventory estimates, mechanisms must be identified that result in release of the inventory from facilities into the vadose zone, unconfined aquifer, or the Columbia River. Because the long-term configuration of the waste inventory depends on future remediation and land-use decisions, a baseline estimate of end-state inventory distributions must be defined.

To date, inventory estimates for radionuclides and hazardous chemicals have been developed within specific projects. These estimates tend to be conservatively high. No comprehensive analysis has been performed that compares and reconciles the estimates for each facility with estimates of the total Hanford Site inventory. A comprehensive integrated analysis will help ensure that estimates for key contaminants are sufficiently accurate and credible to support a site-wide assessment of environmental impacts and risks.

4.2 VADOSE ZONE

The scope of this technical element encompasses the unsaturated zone beneath the Hanford Site. The geographic focus is on areas that (1) underly liquid waste disposal sites; (2) have the potential for leaks or leaching; and (3) have experienced past leaks and spills. Also included are selected areas away from the focus areas, such as areas representative of background conditions and areas that have the potential to become contaminated in the future. Numerical modeling may be made to support the characterization by simulating groundwater flow and contaminant transport processes believed to occur within the vadose zone. Specific topics include (1) subsurface contamination (i.e., characteristics of past disposal and leakage); (2) surface hydrologic features and processes (e.g., winter rain and snowmelt, water line leaks, infiltration, deep drainage, and evaporation rates); and (3) subsurface geologic and hydraulic features and processes (e.g., stratigraphy, structures, physical properties, geochemistry, and microbiology of the sediments above the water table). Information is needed to better understand the vertical and/or horizontal movement of contaminants to the water table.

Sufficient information will be collected to provide (1) an accurate depiction, at appropriate temporal and spatial scales, of contaminant distributions beneath waste, spill, and disposal sites; (2) early warning of potential surface or groundwater contamination problems so that corrective actions can be taken; and (3) credible numerical simulations that acceptably depict the movement and fate of contaminants in the vadose zone. Information generated by this technical element will support remedial actions, such as the design of surface and subsurface barriers, and in situ remediation techniques. It also supports decisions regarding mitigative protective measures (e.g., interim surface covers), restrictions on artificial recharge and, therefore, future land use.

4.3 GROUNDWATER

This technical element provides the information, analytic capabilities, and understanding that are required for technically-sound assessments of Hanford Site impacts to groundwater resources and the Columbia River. The technical scope of the groundwater technical element complements that of the vadose zone element by extending the characterization work into the saturated sediments under the Hanford Site. The saturated zone includes the capillary fringe, the unconfined aquifer, aquitards, and uppermost confined aquifers. Major topics include (1) the distribution of contamination within the saturated sediments; (2) the hydrology, geology, geochemistry, and microbiology of the saturated zone; (3) groundwater flow and transport of contamination; and (4) numerical models that depict the movement of water and contaminants. Data management, presentation, evaluation, interpretation, and reporting are essential components of the technical element.

The geographic scale for groundwater information includes recharge from the uplands to the west of the Hanford Site. Numerical models that represent groundwater movement beneath the Hanford Site require boundaries that may be far removed from the areas of greatest interest, which are the pathways between the contaminant source and the Columbia River. Finer-scale modeling is required to describe and predict flow for specific contaminant plumes, and for interaction by groundwater discharges to the Columbia River.

Information needs include an accurate understanding of current conditions, and the ability to assess potential future conditions, for near- and long-term scenarios. Assessment of groundwater impacts must permit differentiating contamination attributable to the Hanford Site from other sources, such as fallout from nuclear weapons testing and other human activities.

4.4 COLUMBIA RIVER

Technical scope associated with the Columbia River ecosystem extends from reference locations upstream of the Hanford Site to downstream locations appropriate for specific aspects of the system assessment. Environments of interest include the riparian zone, near-river groundwater, the hyporheic zone, and the Columbia River water column. Within each, a wide variety of information is needed to define physical, chemical, and biological characteristics.

The scope of this technical element starts with the zone in which groundwater from the Hanford Site meets the Columbia River. Key topics in this zone include mixing, geochemical conditions, preferential pathways, and biological activity. Credible conceptual and numerical models for processes occurring in this zone are crucial to (1) identifying impacts to the river's ecosystem; and (2) quantifying risks to aquatic and human receptors. This zone encompasses near-river groundwater and infiltrated river water (bank storage), and the hyporheos (sediment pore water and biota immediately beneath the free-flowing stream).

Once in the Columbia River, Hanford Site groundwater and any entrained contamination co-mingle with river water and disperse to a wide array of potential receptors. The scope of this technical element relates to information needs associated with the fate and transport of contamination within this river environment. These include the contaminant characteristics (type, nature, concentration, decay/attenuation qualities), physical movement in the dynamic flow of the river, and bioavailability. Interaction with the suspended load of the river, and with biological systems, is key to anticipating the fate of contaminants. Erosion and deposition patterns for the river are major topics for understanding where potential contaminant sinks are located, and where sensitive species and humans are at greatest potential threat of exposure. Understanding how the channel morphology and its distribution of sediments evolve (with time) is key to anticipating future conditions.

The Columbia River technical element scope includes the capability to provide information necessary to accurately and credibly assess of risk posed by Hanford Site contaminants to aquatic, terrestrial, and human receptors in the river environment. Key information needs include identifying (1) locations where contaminants enter a pathway to receptors; (2) various habitats in the river environment; (3) contaminant-sensitive receptors; and (4) exposure pathways to habitats and receptors.

An understanding of contaminant bioavailability is crucial for assessing potential impacts and risk, and contaminant-transfer coefficients and bioaccumulation rates are needed for contaminant/species combinations of interest. The capability to differentiate Hanford-derived contamination from other sources is a part of this effort, as is analysis of the potential cultural consequences that may result from impacts to the natural resources of the river environment. The assessment of risk considers near-term conditions, as well as conditions extending far into the future.

4.5 MONITORING

The work scope of the monitoring technical element includes sampling and analysis design, logistics, and data management associated with spatial and temporal data for the vadose zone, groundwater, and Columbia River. The new data involve concentrations of radiological and chemical constituents, water level measurements, and other parameters (as required) to support characterization and numerical analyses. New measurements are compared to baselines and previous trends to evaluate if new areas of contamination are developing, if existing plumes are changing, and if remediation has had the desired effect.

The need to monitor any portion of the transport pathway between a contaminant source and the Columbia River is described in the vadose zone, groundwater, and Columbia River technical elements. Because not all waste sites and groundwater plumes can be fully monitored simultaneously, it is necessary to selectively monitor. A higher priority may be assigned based on potential or suspected new contaminant sources (e.g., leaks, spills), proximity to the Columbia River, and site-specific needs to support near-term remediation decisions. Monitoring is required to comply with RCRA, CERCLA, the AEA, and DOE orders.

Monitoring methods include collecting discreet samples of water and soil, and in situ monitoring using pressure transducers for water level measurements, specific ion probes for water quality data, and moisture-sensing instruments. Geophysical tools lowered into boreholes are used for radiological monitoring. Monitoring locations include vadose zone boreholes (dry wells), groundwater wells, riverbank seepage sites, aquifer sampling tubes near the river shoreline, porewater sampling tubes in the riverbed sediments, riverbed sediment, and the river water column.

A primary task of monitoring is detecting (1) new sources of contamination; (2) changes in the movement of existing contamination; and (3) changes in the characteristics of contamination. An equally important task is supplying data to evaluate the performance of remedial actions. The geographic scope varies, depending on the requirements defined by other technical elements, but may extend from contaminant source areas on the Hanford Site to locations in the Columbia River downstream of the Hanford Site.

4.6 RISK ASSESSMENT

The risk assessment technical element involves (1) developing several location-specific dependency webs according to where and when the antecedent transport modules predict that contamination will or could occur (onsite and down river). This is followed by (2) estimating exposures, risks, and impacts to (a) humans, (b) the environment, (c) specific cultures and quality of life, and (d) selected economies from radioactive and chemical contaminants at those locations. These calculations may be made for current contaminant distributions, as defined by monitoring data and information on historical operations, and for potential future conditions. The objectives are to evaluate the effects of various remediation options and land uses.

The first step in the risk assessment process is to develop several location-specific dependency webs before defining impacts and performing the more quantitative exposure, dose, and risk calculations. A variety of tools are needed to conduct these risk assessments because of the relatively large geographic area influenced by the Hanford Site, the complexity of sources and characteristics of contamination, and the migration of contaminants through a variety of environmental media. These tools address the release of contaminants, geochemistry, and transport through a several media (e.g., vadose and saturated zones, river, air, soil), exposures to humans and the ecosystem, human health, ecological, cultural, and economic impacts and risks from the exposure.

Human health risk assessment involves generally accepted exposure pathways and scenarios originally developed and documented by the EPA. Recently, there has been increased interest (e.g., CRCIA and Hanford Remedial Action Environmental Impact Statement [HRA-EIS]) in the assessment of "lifestyle" scenarios that may involve exposure patterns associated with specific groups, such as Native Americans and others whose lifestyles are closely tied to the Columbia River.

Ecological risk assessment is not as easily outlined as human health risk assessment because of the larger number of potential receptors and pathways, which often result in the need for a very location specific analysis. Of particular interest for assessing ecological risk are locations where sensitive habitat and contaminants coexist, and where the potential uptake of contaminants is most likely. A critical location is one where the entry of contaminants into an exposure pathway and/or the food chain is likely to occur. The pathways or mechanisms by which receptors of interest are potentially exposed to contaminants are characterized as an integral part of a risk assessment. Some of the receptors of interest will be identified through identification of the food webs.

The process of estimating risks to cultures and economies uses the same contaminant location, duration, and concentration information as used by the human and ecological risk estimation process. Several models are being developed to address cultural impacts for tribal cultures and communities. These methods are sufficiently well developed, with published proof-of-principle reports, that they can be used by the Integration Project. It is essential, however, that Tribal Nation technical staff be involved in, or actually perform, the evaluation of risks to tribes, their cultures, their economies, and the determination of potentially disproportionate impacts to tribal communities. A standard economic impact analysis will be appropriate for non-tribal economies.

The last step in the risk and impact analyses is to assess cumulative risks and impacts for specific locations and populations. These risks or impacts will be placed into perspective with the other, non-Hanford impacts to the environment.

4.7 REGULATORY PATH

The scope of the regulatory path element involves (1) developing a site-wide approach to the vadose zone, groundwater, and Columbia River assessment that is unified, consistent, and practical; and (2) ensuring that all applicable regulatory requirements are fully addressed by the scope of the associated technical elements. The scope of this element includes the following:

- ***Regulatory Authority.*** This defines the regulatory authority applicable to assessment activities. The lead regulatory authority and secondary authorities will define the process and requirements for regulatory compliance.

- ***Land Use.*** In consultation with stakeholders, land use and associated exposure scenarios will be established for the Hanford Site, and the relationships defined between land use and remediation for RCRA*, CERCLA, *Model Toxic Control Act* (MTCA), and AEA. The exposure scenarios will be a key element of the impact assessment. They will be used to define end states for each environmental media. Land use decisions must be made for the Hanford Site before progress can be made on a unified and cost-effective system assessment.

- ***Constituents of Concern.*** The full range of RCRA hazardous constituents and CERCLA hazardous substances will be identified to ensure consideration in planning data collection and impact assessment work.

- ***Specific Requirements.*** Regulatory requirements specifically applicable to an activity will be identified to ensure consistency of application. Regulatory requirements and constraints will be considered early in planning specific work, and will be accorded attention equal to that given to technical requirements and constraints.

4.8 REMEDIATION OPTIONS

The ultimate goal of Hanford Site mitigation and remediation is to (1) prevent further degradation; and (2) reduce the impact of existing contamination on human health and the environment. Various options currently are being implemented or considered to attain this goal. Objectives that guide selection of remedial actions include the following:

- Reduce or prevent contamination of the Columbia River.
- Remediate areas of soil contamination consistent with land use goals.
- Control and/or stabilize sources of contamination.
- Contain and/or remove solid waste stored in landfills.
- Remediate and/or contain groundwater contamination.

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* Although the term "RCRA" is used throughout this technical element, it is implicit that many elements of the federal RCRA program have been delegated to the state of Washington and are implemented through the state's *Dangerous Waste Program*.

Interim Actions. Interim remediation is undertaken to mitigate a contamination problem prior to obtaining sufficient information to make a final closure or remediation decision. These actions include expedited response actions (ERAs) and interim remedial measures (IRMs). The activities are intended to accelerate cleanup, in order to control further spread of contamination at inactive facilities. Surveillance and monitoring activities at inactive facilities and waste sites are used to verify that an acceptable condition exists until full-scale remedial actions are initiated.

Remediation Alternatives. Selecting an alternative for near-term remediation involves evaluating the available options in light of site conditions and types of contamination. Remediation alternatives that have been successfully implemented on the Hanford Site, or that are considered to have potential application, include the following: no action; institutional controls; engineered surface barriers; removal and disposal; and pump-and-treat.

No action is required to be evaluated as a baseline for comparison with other remedial alternatives. For the no-action alternative to be selected, a site (in its current condition) must pose no unacceptable threat to human health and the environment.

Institutional controls involve the use of physical barriers (fences) and deed restrictions on access to reduce or eliminate exposure to contamination. Institutional controls are often coupled with groundwater, vadose, surface soil, biotic and/or air monitoring to ensure that exposures are limited by the imposed controls. Many access and land use restrictions are currently in place at the Hanford Site, and will remain during remedial work.

Engineered surface barriers (i.e., caps) function as hydraulic barriers to control the amount of water infiltrating into contaminated media, thus reducing potential leaching of contamination to groundwater. In addition to their hydraulic performance, barriers also function as a physical limit to direct human and biotic interaction with contamination. Barriers are engineered to limit wind and water erosion and, if needed, can control the release of accumulated gases or attenuate radiation.

Removal and disposal involves the excavation of contaminated material and ultimate disposal in a landfill or other environmentally safe configuration. Depending on the nature (e.g., radioactivity levels, hazardous waste classification) of the waste removed, ex situ treatment may be performed prior to disposal.

Removal and disposal are effective because contaminated materials are physically removed; there are no long-term requirements for monitoring and maintenance of the site; and there is greater flexibility in future land use. These methods are easily implemented at sites with shallow contamination. Requirements for safety, monitoring, and sampling are generally well understood. Radioactive waste require special handing protocols, and may require remotely controlled equipment if radiation levels are high to preclude the use of standard construction equipment.

Groundwater pump and treat involves the extraction and ex situ treatment of contaminated groundwater, and can be effective for a variety of contaminants. This alternative can also be used to hydraulically control the movement of contaminants in groundwater, to remove contaminant mass, and/or reduce contaminant concentrations. A variety of ex situ treatment processes, such as ion exchange, carbon absorption, and air stripping, are available to address a wide range of contaminants. Pump and treat is a well-developed, commonly used technology that can be easily implemented. Pump and treat systems have been applied at the Hanford Site to remove contaminant mass and/or control contaminant plume movement. The effectiveness of a pump and treat system to remove contaminants diminishes as contaminant levels decrease and, depending on cleanup goals, a shift to an alternative remediation technology (such as in situ treatment) may be needed.

Other Technologies. In situ treatment technologies include a broad range of processes in which waste, contaminated soil, or groundwater is treated or immobilized in place. This feature is advantageous when exposure or worker safety concerns are significant, such as during excavation or where deep vadose zone contamination exists and excavation or placement of surface barriers is impractical or ineffective. Examples of in situ treatments include in situ vitrification, in situ stabilization, soil vapor extraction, and in situ biotreatment. In situ vapor extraction currently is being used to remediate carbon tetrachloride contaminated soil at the 200-ZP-2 operable unit. Examples of in situ groundwater treatments include air sparging and reactive walls.

Monitored Natural Attentuation. Natural attenuation is a passive rather than active treatment. It encompasses natural processes to reduce contaminant toxicity, mobility or volume. Natural attenuation processes include radioactive decay, biodegradation, biological stabilization, volatilization, dispersion, dilution, chemical or biological stabilization, transformation or destruction, adsorption and desorption, and mineral precipitation.

4.9 SYSTEM ASSESSMENT

The system assessment technical element quantifies the environmental consequences of past, present, and future Hanford Site activities on the vadose zone, groundwater, and the Columbia River. Assessment capabilities evaluate the affects of residual contamination from past activities, as well as potential future contamination. The scope of the system assessment technical element includes designing, developing, and applying assessment methods that meet the objectives of the Integration Project. This technical element also provides a vehicle to integrate activities and information generated by the other technical elements, so that coherent and consistent information is available for making major cleanup decisions. The iterative aspect of (1) defining requirements and objectives; (2) obtaining required information and data; (3) interpreting and using the new information; and (4) evaluating the new information in terms of the original requirements is part of this technical element.

The scope and results of assessments made for specific projects, which may be at physical and temporal scales that are more highly resolved than those for an overall system assessment, are coordinated within the system assessment technical element. This integration ensures that the system analysis is reasonably complete and adequate, and that it is internally consistent.

The system assessment scope is oriented toward site-wide and broader scales which consider the significant components of the natural system and waste management issues when evaluating environmental and human health consequences. As a result, system assessments tend to be directed at the longer-term consequences of contaminants in the environment. However, because of the need to evaluate mitigation and remediation alternatives, and impacts from past discharges to the environment, system assessment capabilities must also include near-term durations.

To ensure the coordination and overall consistency of analyses contributing to the system assessment, the system assessment technical element establishes common requirements for shared databases and consensus interpretations of the environmental setting. This technical element is responsible for data-sharing structures. The data-sharing structure recognizes the multiple temporal and spatial scales of observations and required assessments, and ensures that consistent methods are employed for scales ranging from an individual pore or mineral-grain surface to the regional aquifer and the Columbia River.

Once system requirements and standards are agreed upon, they are imposed for all technical elements and scales of analysis. This process ensures completeness and consistency for analyses conducted for other technical elements (e.g., the vadose zone and the groundwater technical elements). In turn, this ensures the applicability of results at a system-assessment scale.

The system assessment technical element is responsible for reconciling technical differences at interfaces between technical elements. For example, the vadose zone technical element provides estimates of past and future releases of contaminants from the vadose zone to the uppermost aquifer. Similarly, the groundwater technical element provides estimates of current and future contaminants within the uppermost aquifer. If the estimate of past releases of vadose zone contaminants to the aquifer fails to agree with the estimate of contaminants in the aquifer, then the system assessment technical element, which uses results of both the vadose zone technical element and the groundwater technical element, must satisfactorily resolve the difference.

5.0 PROJECT APPROACH

This section describes the general approach, process, and organizing principles that will be used to remedy the fragmentation that has characterized past approaches to characterization and impact assessments of Hanford Site contamination. Details of the management approach and structure are presented in the PMP. The general approach is to (a) identify organizational overlaps and other inefficiencies; (b) identify deficiencies in knowledge and the work needed to fill those deficiencies; and (c) use the knowledge from *a* and *b* to expeditiously implement appropriate remedies.

5.1 APPROACH TO ACCOMPLISH THE PROJECT MISSION

Broad aspects of the approach that the Integration Project will use to carry out its mission are illustrated in Figure 5-1, which depicts a four-step approach that will be applied annually to support the development of the *Detailed Work Plan* (DWP). The four steps are Project Definition, Deficiencies Assessment, Work Scope Definition, and Work Scope Approval.

Project Definition. The key documents that define the project are the *Project Specification*, the PMP, and the *Tribal Government Consultation and Public Involvement Plan.* These documents identify the scope, requirements, strategy, roles, responsibilities, and participation aspects of the Integration Project. The documents should require minimal change or updating, which will be done on an annual basis.

Deficiencies Assessment. The deficiencies assessment is designed to systematically review and evaluate work scope, technical capabilities, and the technical knowledge base, using the framework of technical elements described in Section 4.0. The assessment process results in the identification of knowledge, data, and capability gaps, as well as inefficiencies or overlaps in work scope. The processes used for the deficiencies assessment and the recommendation of remedies are documented in the *Project Baseline*. The first deficiencies assessment will be a major focus of the Integration Project. Annual assessments will be made for subsequent, incremental improvements.

Work Definition. The results of the deficiencies assessment form the basis for identifying work to be defined in the DWP. Identified gaps, inefficiencies, and overlaps are first compared to ongoing work that may provide data or information to resolve the deficiency. If ongoing work is unlikely to provide the information that is needed, new work scope is identified or existing work is redirected. Determination of work priorities is a process focused on assurance that appropriate, essential work scope is completed on time, and that work activities constitute an appropriate expenditure of public funds. The process used to determine priorities is described in more detail in Section 6.0.

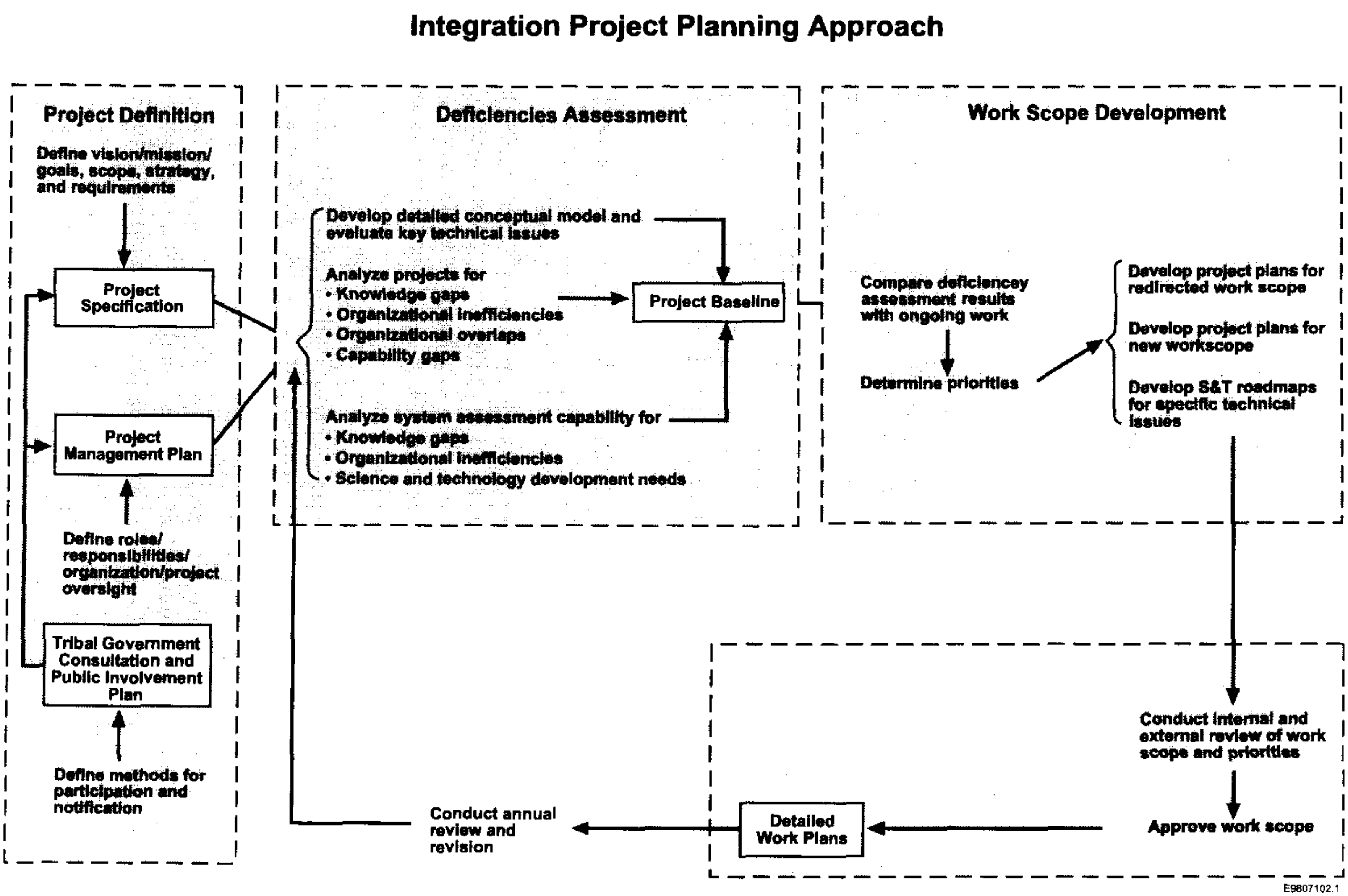


Figure 5-1. Integration Project Planning Approach.

Once priorities have been assigned, the work scope will be defined, reviewed, and approved. Organizations responsible for the work are identified in the PMP.

Work Review and Approval. Final work review and approval involves internal and external review of the proposed work scope and assigned priorities. The process will be open to public comment. Tribal Nations and stakeholders are encouraged to provide comments for consideration in the final approval process before work scope is incorporated into the DWP.

5.2 PROCESS FOR IDENTIFYING INTEGRATION PROJECT WORK SCOPE

The ways in which the Integration Project will fulfill its mandate to eliminate inefficiencies inherent in the current multi-project fragmentation of work scope, while resolving knowledge gaps, are shown in Figure 5-2. Project responsibilities are viewed in terms of *Fact-finding, Analysis*, and *Remedy Formulation*, and *Implementation*. Integration of these responsibilities with respect to ongoing work of contributing projects will initially occur through a process of *Deficiencies Assessment* that is expected to result in recommendations of change. Deficiencies assessment encompasses both fact-finding and analysis. Its objective is to identify needed technical and organizational changes. Subsequent integration of project responsibilities with the work of contributing projects will be through remedy formulation and implementation.

Fact-finding involves investigation of potential organizational overlaps and inefficiencies, and gaps between data needs and data collected by contributing projects. Current contributing projects are described in Appendix D2.

Analysis involves assessment of the causes and effects of knowledge gaps and organizational inefficiencies. Its purpose is to assess (1) needs to develop new scientific approaches and technology; and (2) relationships of Integration Project priorities to the priorities of contributing projects.

To redress identified deficiencies, *Remedy Formulation* determines what new work is needed; how ongoing work should be redirected; and how work should be reorganized and managed.

Remedies are applied either through (a) direct Integration Project intervention; or (b) the formulation of science and technology roadmaps developed with the help of DOE's national laboratories and other pertinent sources of research and development. Remedies are implemented through feedback to both data collection and assessment capabilities.

Deficiencies assessment has been the focus of the Integration Project in FY98. The focus during FY99 (and beyond) will be on implementing remedies (Figure 5-2) and providing the feedback required for continued incremental improvements.

Aspects of the deficiencies assessment process are shown in Figure 5-3. The process is applied, as appropriate, to each of the nine technical elements shown in Figure 4-1. Input to the deficiencies assessment is being sought from regulatory agencies, affected Tribal Nations, special interest groups, the public, DOE national laboratories, the National Academy of Sciences

Figure 5-2. Remedy Formulation and Implementation.

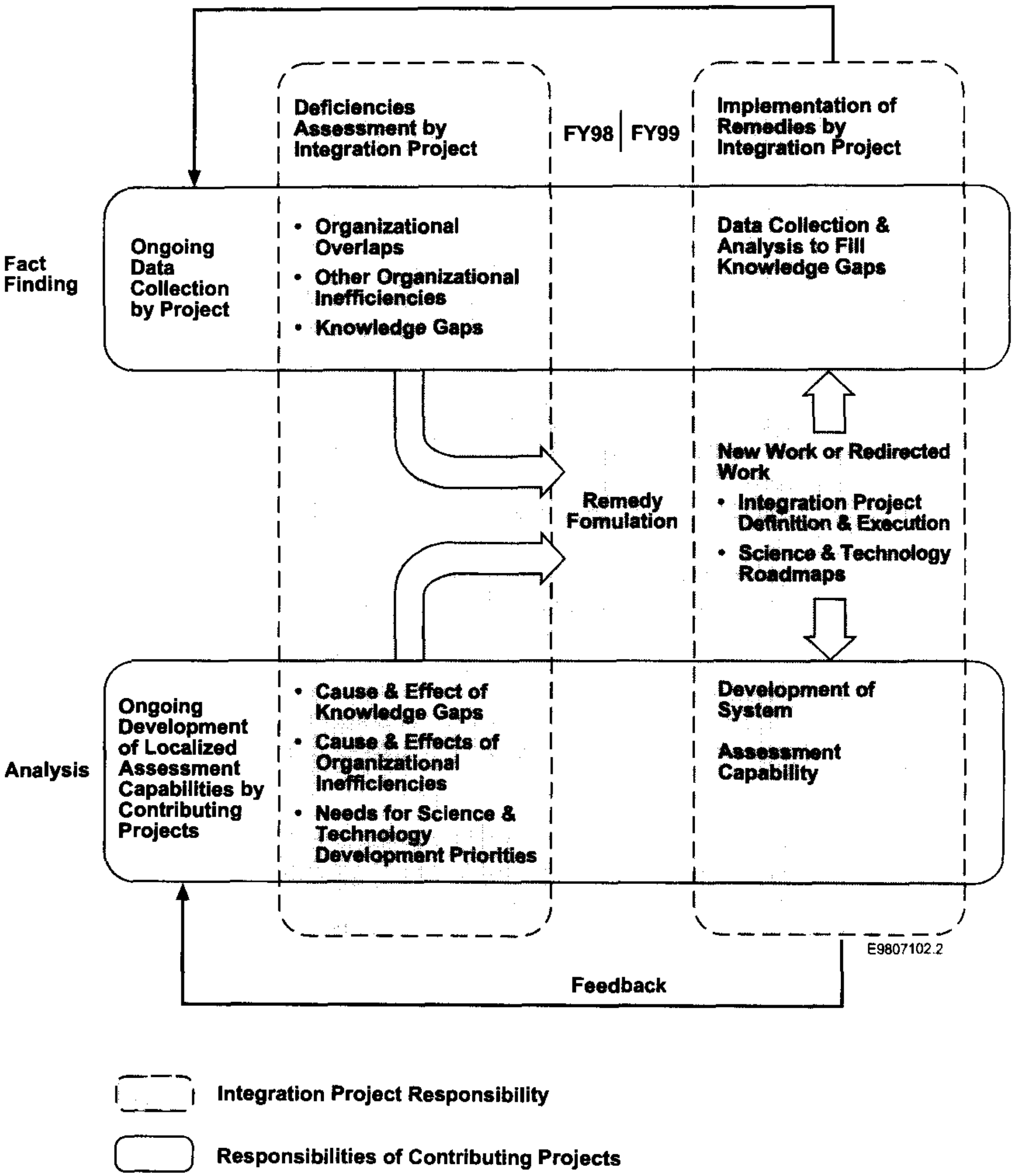
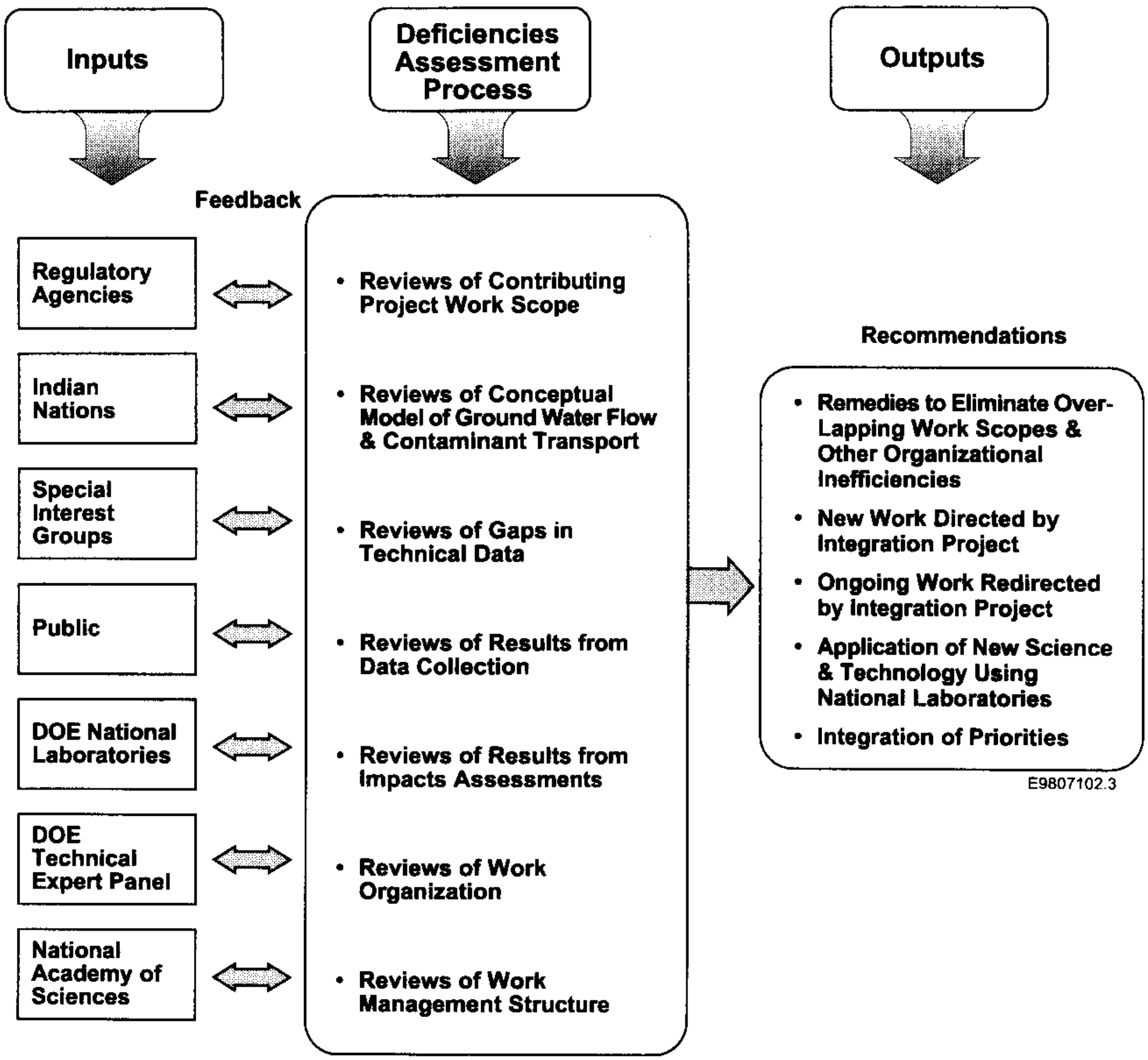


Figure 5-3. Process for Deficiencies Assessment.



(NAS), and the DOE Expert Panel. In turn, feedback from the deficiencies assessment process will be provided to all entities providing input to the assessment.

The assessment process involves reviews by the following:

- The Integration Project, on project overlaps, gaps in technical work scopes, and organizational inefficiencies.

- The national laboratories, on the Hanford Site's conceptual model of groundwater flow and contaminant transport, and gaps in technical data that support the conceptual model.

- The Expert Technical Panel, and the NAS, on the adequacy of results and conclusions from data collection, analysis, and impacts assessment.

Results from the deficiency assessment process will be expressed as recommendations for change. The assessment is expected to result in specific recommendations related to the following kinds of changes:

- Elimination of overlaps in scope and other organizational inefficiencies.
- New work directed by the Integration Project to fill gaps in technical knowledge.
- Redirection by the Integration Project of ongoing work, as appropriate.
- Application of new science and technology by the National Laboratories, as needed.
- Integration of priorities between this project and other contributing projects.

6.0 PROCESS FOR DETERMINING WORK PRIORITIES

The Integration Project must identify and apply widely acceptable and effective criteria for determining work scope priorities, in order to achieve the project's objectives. The criteria established by contributing projects are often much more narrowly focused, and must also be incorporated. Criteria may conflict because of differing scopes, regulatory requirements, and scales of assessment. The Integration Project will ensure that contributing project priorities are maintained while still adhering to its mission to address larger-scale issues.

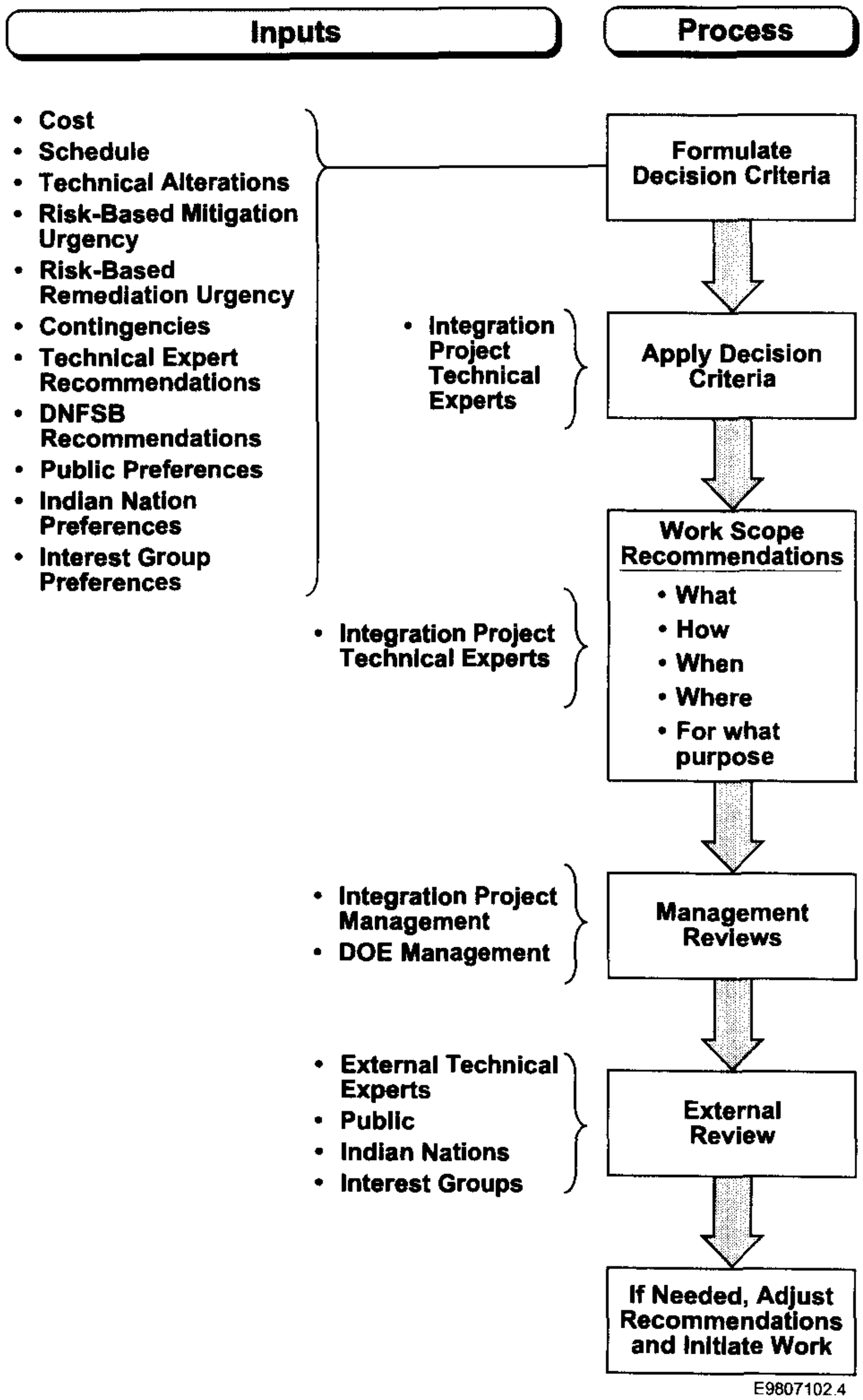
The general approach and process that will be used by the Integration Project to identify gaps in essential knowledge, overlaps of work scope, and other organizational inefficiencies, along with their remedies, are described in Section 5.0. Application of this approach will probably identify more than one potential remedy, or a combination of prospective remedies for a specified data or information deficiency. Similarly, the elimination of one deficiency may alleviate or eliminate the necessity to redress another. Alternatively, reorganization or redirection of the manner in which pertinent work currently is organized or conducted may obviate the need to initiate new work.

To make these kinds of decisions, the Integration Project, with the help of other entities will use the process shown in Figure 6-1. The decisions will entail (1) what work is needed; (2) how it is to be done; (3) when it will be accomplished; (4) where the work will be applied; and (5) for what purpose.

Decision Criteria Formulation is the identification of criteria that will be applied to identify work scope priorities for the Integration Project. The Integration Project will ensure compliance with the Hanford Site's general criteria for establishing the priorities of any project. This criteria include the following:

- Establish and maintain safe operations.
- Maintain essential services.
- Mitigate urgent risks.
- Ensure compliance with all applicable laws, regulations, DOE orders, agreements, consent orders, and Defense Nuclear Facilities Board recommendations.

Figure 6-1. Work Priority Determination.



More specifically, the Integration Project will develop priority decision criteria by soliciting and using input from DOE's technical expert panel, national laboratories, Hanford Site projects, regulators, and the expressed preferences of the public, Tribal Nations, and special interest groups. These expressions of preference and concern will be utilized in the context of the following factors:

- Cost relative to budget.
- Schedule, as driven both by internal needs and regulatory commitments.
- Alternatives for obtaining needed information.
- Alternatives that may obviate the need to obtain information.
- Risk-based mitigation urgency.
- Risk-based remediation urgency.

Application of Decision Criteria will be used by technically knowledgeable members of the Integration Project, who will be selected by project consensus, based on their ability to maintain a broad, integrated view of the project's objectives. The project's Work Scope Priorities Committee will be comprised of at least one, but no more than two, representatives from each major Integration Project participant (i.e., the ERC, PHMC, and PNNL).

Work Scope Recommendations will be made at least annually by the Work Scope Priorities Committee as part of the development process for *Project Baseline* and DWP documentation. However, the committee will also meet on a quarterly basis to review progress and, as needed (based on new information), update the annual recommendations. A formal change request and approval process will be required to make any changes to the *Project Baseline* and DWP.

Management Reviews of the recommended work scope will be made by the Integration Project and RL. As needed, adjustments will be made to the committee's recommendations, and the revised work scope proposal will be issued for *external review* and comment by technical experts, the public, Tribal Nations, and special interest groups. After final adjustments and management approval, the approved work scope will be documented in the *Project Baseline* and the DWP.

APPENDIX A

COMPARISON MATRIX OF INTEGRATION PROJECT DOCUMENTS AND GROUNDWATER PROTECTION MANAGEMENT PLAN (GPMP) REQUIREMENTS

APPENDIX A

Comparison Matrix of Integration Project Documents and Groundwater Protection Management Plan (GPMP) Requirements

This attachment provides a comparison between the requirements for a GPMP and the GW/VZ Project documentation that will address specific GPMP requirements. The GW/VZ Project will address the requirements through the *Project Specification*, the PMP, and the *Integrated Baseline*, which includes the DWP, implementation schedules, and other supporting documents. Two designations have been included in the table below:

"A" – designating where the requirement will be primarily addressed.

"B" – designating where summary or additional information relative to the requirement can be found.

GROUNDWATER PROTECTION MANAGEMENT PLAN (DOE ORDER 5400.1) AND THE CORRESPONDING INTEGRATED PROJECT DOCUMENTATION			
Requirements from DOE Order 5400.1	**Project Specification**	**Project Mgmt. Plan**	**Integrated Baseline**
1. Groundwater Protection Management Program.			
a) Document the groundwater regime with respect to quantity and quality.	B (App. D)		A
b) Design and implement a groundwater monitoring program to support resource management and comply with applicable environmental laws and regulations.	B (App. D)		A
c) Establish a management program for groundwater protection and remediation, including specific Safe Drinking Water Act (SDWA), Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions.	A (1.0/2.0/App. D)	B	B
d) Summarize and identify areas that may be contaminated with hazardous substances.	B (App. D)		A
e) Provide for control of sources of these contaminants.	A (App. D)	B	B
f) Provide for a remedial action program that is part of the CERCLA program required by DOE 5400.4.	A (App. D)	B	B
g) Provide for decontamination and decommissioning, and for other remedial programs contained in DOE directives.	A (App. D)	B	B

GROUNDWATER PROTECTION MANAGEMENT PLAN (DOE ORDER 5400.1) AND THE CORRESPONDING INTEGRATED PROJECT DOCUMENTATION			
Requirements from DOE Order 5400.1	**Project Specification**	**Project Mgmt. Plan**	**Integrated Baseline**
2. Groundwater Monitoring Program.			
a) A Groundwater Monitoring Plan shall be developed as a specific element of all environmental monitoring plans, and the Groundwater Protection Management Program. The Groundwater Monitoring Plan shall identify all DOE requirements and regulations applicable to groundwater protection, and will include a monitoring strategy. The elements of the Groundwater Monitoring Program shall be specified (sampling plan, sampling, analysis, and data management), along with the rationale and purpose for selecting these elements.			A
3. General Requirements of the Groundwater Monitoring Program			
a) Obtain data for the purpose of determining baseline conditions of groundwater quality and quantity.			A
b) Demonstrate compliance with the implementation of all applicable regulations or DOE orders.			A
c) Provide data to permit the early detection of groundwater pollution and contamination.			A
d) Identify existing and potential groundwater contamination sources and maintain surveillance of these sources.			A
e) Provide data upon which decisions can be made concerning land disposal practices and the management and protection of groundwater resources.			A
f) Identify site-specific characteristics that shall determine monitoring needs.			A
***Technical Standard for GPMP**	**Project Specification**	**Project Mgmt. Plan**	**Integrated Baseline**
1. Establish overall site-wide groundwater protection and remediation goals.			
a) Write goal statements that (1) provide specific, site-wide goals for setting and reviewing environmental objectives and targets; (2) account for present and future uses of the groundwater resource; (3) are measurable in terms of progress; and (4) are documented, implemented, maintained, and communicated to appropriate DOE and contractor staff.	A (3.2)		
b) Relate goal statements to site-specific groundwater and related conditions.	A (3.2)		
c) Determine whether the groundwater protection and remediation approach will be risk-based or resource-based.	A (3.2)		
d) Evaluate progress toward accomplishing the goals.			A
2. Ensure that all Federal, State, and other requirements are being met.			
a) Identify applicable requirements.	A (2.1)		
b) Identify the organizational unit responsible for compliance with these requirements.	B (2.1/ App. D)	A	
c) Establish procedures.		A	
d) Document decisions to ensure compliance.	B (2.1/ App. D)	B	A

GROUNDWATER PROTECTION MANAGEMENT PLAN (DOE ORDER 5400.1) AND THE CORRESPONDING INTEGRATED PROJECT DOCUMENTATION			
Requirements from DOE Order 5400.1	**Project Specification**	**Project Mgmt. Plan**	**Integrated Baseline**
3. Provide a mechanism for integrating groundwater protection with all site-wide operations.			
a) Coordinate site-wide programs affecting groundwater. These programs may include, but are not limited to, the following: waste management (including low-level waste performance assessment); environmental monitoring; environmental remediation; facilities and operations; underground storage tanks; future-use (e.g., land-use) planning; and water use/disposal.	B (1.0/3.2/5.0/ App. D)	A	B
b) Establish a work group or committee consisting of appropriate representatives of both RL and contractors.		A	
c) Identify site-wide organizations and individuals with groundwater protection responsibilities.		A	
d) Establish regular communication mechanisms between all site-wide programs with groundwater responsibilities.		A	
e) Develop a site-wide self-assessment.		A	
4. Identify potential sources of groundwater contamination.			
a) Establish a source-water protection program that sets priorities to identify sources of contamination and current or potential uses of groundwater; identifies current or potential uses of groundwater; identifies potential sources of contamination; and develops a system for ranking potential sources by degree of risk.	A (1.0/App. D)	B	B
b) Inventory Class V miscellaneous injection wells.	B (App. D)		A
c) Inventory injection wells under other classes.	B (App. D)		A
d) Identify miscellaneous waste streams.	B (App. D)		A
e) Identify the location of potential contaminants relative to particularly valuable groundwater or to groundwater that is highly vulnerable to contamination.	B (App. D)		A
5. Identify control strategies for preventing future contamination and remediating existing conditions.			
a) Identify control strategies for prevention of future contamination. Aspects of many programs may be relevant to preventing future groundwater contamination (e.g., pollution prevention; waste minimization; spills prevention, control, and countermeasures; well closure and abandonment; purge water management; and management of other investigation derived wastes).	A (App. D)	B	B
b) Identify control strategies for integration of waste management.	A (App. D)	B	B
c) Identify control strategies for integration of environmental remediation	A (App. D)	B	B
6. Provide a network for monitoring groundwater quality.			
a) The design criteria used in developing the network should be clearly identified.	A (4.5/ App. D)		B
b) Data management and reporting systems should be maintained in a coherent site-wide manner.		A	

GROUNDWATER PROTECTION MANAGEMENT PLAN (DOE ORDER 5400.1) AND THE CORRESPONDING INTEGRATED PROJECT DOCUMENTATION			
Requirements from DOE Order 5400.1	**Project Specification**	**Project Mgmt. Plan**	**Integrated Baseline**
c) On-going management (assessment and modification) of the monitoring network is needed to address changing contaminant distributions, site conditions, and budgets.	B (4.5/ App. D)	B	A
d) Identify innovative monitoring techniques that have the potential to provide better quality and less expensive data.	B (4.5/ App. D)		A
7. Provide basic technical data on subsurface conditions.			
a) Identify subsurface investigation data needs that support the groundwater monitoring, resource evaluation, waste management, and environmental remediation objectives.	A (4.2/4.3/ App. D)	B	B
b) Prioritize new studies and coordinate between areas or programs.		B	A
c) Identify or establish a subsurface studies information repository.		A	
8. Identify specific technical methods for site-wide use to achieve comparable groundwater information.			
a) Identify standard subsurface investigation methods to be used site-wide, ensuring comparable protocols with acceptable QA/QC procedures, and which meet minimum data quality requirements.		B	A
b) Establish a process for adopting site-wide standard methods.		A	
c) Use best management practices where appropriate.		A	
d) Integrate procedures and methodology information with database design.		A	
9. Incorporate site outreach program efforts into groundwater protection programs.			
a) Define and fund an outreach program.		A	B
b) Identify external audiences and their interests.		A	
c) Decide on methods of communication.		A	
d) Plan a response system.		A	
e) Provide groundwater information to interested parties.		A	
f) Provide meaningful opportunities to participate in the process of developing the GPMP.		A	

****GPMP Standards Source: DOE Draft Guidance for Preparation of Groundwater Protection Management Plans***

APPENDIX B

PERTINENT FEDERAL AND STATE LAWS AND REGULATIONS

APPENDIX B

Pertinent Federal and State Laws and Regulations

Table B-1. Federal Laws, Regulations, and DOE Orders.

Citation	Requirement	Application
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9602-9604, as amended		
National Oil and Hazardous Substances Pollution Contingency Plan, Subpart E, 40 CFR 300.400	Establishes the process to be followed upon discovery of a release of a hazardous substance, including notification, site evaluation, and remedial response. Establishes CERCLA remediation criteria consisting of a risk range of 10^{-4} to 10^{-6} for carcinogens and a hazard index of less than 1 for noncarcinogens.	CERCLA hazardous substances have been released to the vadose zone and groundwater and, as a result, the 100, 200, and 300 Areas are identified on the National Priorities List for action under CERCLA.
Designation, Reportable Quantities, and Notification, 40 CFR 302	Defines the comprehensive list of hazardous substances regulated under CERCLA. Imposes reporting requirements in the event of a release in excess or reportable quantities.	CERCLA hazardous substances are present in the vadose zone and groundwater.
Safe Drinking Water Act of 1974, 42 USC 300, et seq.		
National Primary Drinking Water Standards, 40 CFR 141	Establishes maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) that are drinking water criteria designed to protect human health from the potential adverse effects of contaminants in drinking water.	Groundwater at the Hanford Site is not a current drinking water source, but it is considered a potential future source of drinking water using EPA's groundwater classification strategy. In addition, Hanford groundwater is hydraulically connected to groundwater that is used for drinking water and to the Columbia River. MCLs and MCLGs should be considered in establishing cleanup levels that are protective of groundwater, points of compliance, and institutional controls.
National Secondary Drinking Water Standards, 40 CFR 143	Establishes secondary drinking water standards for use in establishing cleanup levels.	Federal secondary standards are not enforceable standards and are not typically applicable or relevant and appropriate requirements; however, the State of Washington Model Toxics Control Act requires that these standards be considered in establishing cleanup levels protective of groundwater.
Clean Water Act of 1977, 33 USC 1251, as amended		
Water Quality Standards, 40 CFR 131	Establishes the requirements and procedures for states to develop and adopt water quality standards based on federal water quality criteria that are at least as stringent as the federal standards. Provides EPA authority to review and approve state standards. Washington State has received EPA approval and has adopted more stringent standards under WAC 173-201A.	Not applicable (the requirement to develop standards applies to the states, not individual facilities) but relevant in establishing the basis for state regulation.

Table B-1. Federal Laws, Regulations, and DOE Orders.

Citation	Requirement	Application
Atomic Energy Act of 1954, as amended, 42 USC 2011, et seq.		
Department of Energy Occupational Radiation Protection, 40 CFR 835	These requirements set occupational dose limits for adults. Total effective dose equivalent is equal to 5 rem/yr	These standards are applicable when performing any assessment or response actions.
DOE Order 5400.5, Radiation Protection of the Public and the Environment, and 10 CFR 834 (Proposed)	This DOE order sets radiation standards for protection of the public in the vicinity of DOE facilities. The order set limits for the annual effective dose equivalent of 100 mrem, but allows temporary limits of 500 mrem if avoiding the higher exposures is impractical. The standard sets annual dose limits for any organ at 5 mrem. The order sets an annual dose equivalent from drinking water supplies operated by DOE at 4 mrem, and states that liquid effluent from DOE activities will not cause public drinking water systems to exceed EPA MCLs. The proposed rule, Radiation Protection of the Public and the Environment (10 CFR 834), in the March 23, 1993 Federal Register (58 FR 16268), promulgates the standards presently found in DOE Order 5400.5. The proposed rule identifies DCGs not as "acceptable" discharge limits, but to be used as reference values for estimating potential dose and determining compliance with the requirements of the proposed rule. Where residual radioactive materials remain, the proposed rule states that various disposal modes should address impacts beyond the 1,000-year time period identified in the existing DOE Order.	Both the DOE order and the proposed rule are relevant in assessing risks associated with existing contamination and identifying appropriate response actions.
DOE Order 5820.5, Radioactive Waste Management	These guidelines set performance objectives to limit the annual effective dose equivalent beyond the facility boundary to 25 mrem. Selected disposal methods must be sufficient to limit the annual effective dose equivalent to 100 mrem for continuous exposure, or 500 mrem for acute exposures when active institutional controls are removed.	The order is applicable to any radioactive waste that is present in Hanford Site waste management units, or for waste that might be generated during assessment or response actions.
Nuclear Regulatory Standards for Protection Against Radiation, 10 CFR 20	The regulation establishes standards for protection of the public against radiation arising from the use of regulated materials. Remedial alternatives need to limit external and internal exposure from releases to levels that do not exceed 100 mrem/yr total effective dose equivalent, or 2 mrem/hr from external exposure in unrestricted areas. These requirements also establish criteria for closing NRC-licensed sites, including a standard of 25 mrem/yr from all sources, and reducing residual radioactivity to levels that are as low as reasonably achievable (ALARA).	The regulation is not strictly applicable at the Hanford Site because it applies to NRC-licensed facilities. However, it is relevant and appropriate because it establishes standards for protection of the public against radiation.
EPA Memorandum, Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination," OSWER No. 9200.4-18	This memorandum provides guidance on cleanup levels at CERCLA sites. EPA has determined in this directive that dose limits established by the NRC in 10 CFR 20 (25 mrem/yr and ALARA) are generally not protective at CERCLA sites, and instead states that a cleanup level of 15 mrem/yr is protective of human health and the environment. EPA dose limits are to generally achieve risk levels in the 10^{-4} to 10^{-6} risk range.	The standard established in this memorandum is considered protective by EPA in lieu of the NRC standards and is relevant in establishing cleanup levels.

Table B-1. Federal Laws, Regulations, and DOE Orders.

Citation	Requirement	Application
Licensing Requirements for the Land Disposal of Radioactive Waste, 10 CFR 61	Requires that disposal systems be designed to limit the annual dose equivalent beyond the facility boundary below 25 mrem to the whole body, 75 mrem to the thyroid, or 25 mrem to any other organ. The systems must be relevant and appropriate to remedial actions that include land disposal or release radioactive effluent. Inadvertent intruder requirements for land disposal units are also contained in this regulation	The regulation is not strictly applicable because it applies to land disposal of radioactive wastes containing byproduct, source, and special nuclear material received from other persons. However, it is relevant and appropriate if radioactive waste will be left in place following remediation. Requirements to protect inadvertent intruders may also be relevant and appropriate in assessing risks and determining appropriate response actions.
Packaging and Transportation of Radioactive Material, 10 CFR 71	These requirements apply to the packaging, preparation for shipment, and transportation of licensed radioactive material.	The regulation is not strictly applicable because the Hanford Site is not NRC-licensed. However, radioactive waste might be generated during assessment or response actions, and subparts of this regulation are relevant and appropriate for packaging, testing, and preparation of packages containing radioactive material.
Environmental Radiation Protection Standards for Nuclear Power Operations, 40 CFR 190	Specifies the levels below which normal operations of the uranium fuel cycle are determined to be environmentally acceptable. The standard sets dose equivalents from the facility that are not to exceed 25 mrem/yr to whole body, 75 mrem/yr to thyroid, or 25 mrem/yr to any other organ.	These standards are not strictly applicable at the Hanford Site, because the standard excludes operations at disposal sites and uses a definition of the uranium fuel cycle that focuses on those processes that result in generation of electrical power. However, the standards are relevant and appropriate in the assessment because they address acceptable dose to the public.
Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes, 40 CFR 191	Establishes standards for management and disposal of spent nuclear fuel, high-level waste, and transuranic wastes at facilities operated by the DOE. The standard addresses all disposal methods. Subpart A applies to facilities regulated by the NRC, and sets maximum committed effective dose of 15 mrem/yr for any member of the public. Environmental standards set in Subpart B address protection of individual members of the public and groundwater at disposal facilities. Appendix A provides numeric standards for potential future releases.	The requirements are applicable because high-level wastes and transuranic wastes are present at the Hanford Site, and must be addressed during closure of waste units and/or remediation of environmental media.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, 40 CFR 192	Standards for cleanup are set under this program, including groundwater protection requirements for radium-226, radium-228, and gross alpha particle activity, which are set at levels established under state and federal water quality criteria programs.	The standard is not strictly applicable because the Hanford Site is not a uranium or thorium milling site. However, standards for cleanup set under this program are relevant and appropriate to assessment and response actions conducted at the Hanford Site.
Resource Conservation and Recovery Act, 42 USC 6901, et seq.		
Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR 257	Criteria specified under this standard are used to determine which solid waste disposal facilities and practices pose a reasonable possibility of adverse risk to human health and the environment.	Although Hanford has solid waste disposal facilities, most of the provisions of this chapter have been delegated to the state. (See Table B-2, Hazardous Waste Management Act.)

Table B-1. Federal Laws, Regulations, and DOE Orders.

Citation	Requirement	Application
Identification and Listing of Wastes, 40 CFR 261	This part establishes the framework for determining whether a waste is hazardous, including testing methods, criteria for characteristic waste, and definitions of listed wastes.	Although hazardous waste is present at the Hanford Site, and might be generated during assessment and response actions, most of the provisions relative to designation have been delegated to the state.
Generator Standards, 40 CFR 262, Standards Applicable to Transporters of Hazardous Waste, 40 CFR 263, Standards for Owners and Operators of TSD Units, 40 CFR 264 and 265	Establishes specific requirements for facilities that generate, transport, store, treat, and/or dispose of hazardous waste. Requirements cover such items as permitting, waste unit design and operation, training, and emergency preparedness planning.	Although hazardous waste is present at the Hanford Site and might be generated during assessment and response actions, most of the provisions relative to waste generation and management have been delegated to the state.
Groundwater Protection Standards, 40 CFR 264.92	Three remediation levels of groundwater protection established by this section are background, MCLs, and ACLs. MCLs are set at the same levels as SDWA MCLs. Where no SDWA MCL has been set, health-based ACLs may be established that are protective of human health and environment.	Groundwater restoration goals established by this section are relevant and appropriate in establishing soil cleanup levels that are protective of groundwater.
Corrective Action for Solid Waste Management Units, 40 CFR 264, Subpart S (proposed)	Identifies a process for implementing corrective action under RCRA, and establishes chemical-specific soil cleanup levels that are protective based on direct exposure.	Releases from solid waste management units will be considered in the assessment and in identifying response actions. Soil remediation goals established by this section may be pertinent to the establishment of soil cleanup levels. Because this is a proposed rule, it is not strictly applicable at this time.
Land Disposal Restrictions, 40 CFR 268	These requirements prohibit the placement of restricted RCRA hazardous wastes in land-based units until treated to standards considered protective for disposal. Specific treatment standards are included in the requirements.	These requirements are applicable if restricted waste is generated during assessment or response actions.
Toxic Substances Control Act (TSCA), 15 USC 2601 et seq.		
Regulation of PCBs, 40 CFR 761	These requirements identify standards applicable to the handling and disposal of PCBs above 50 ppm. Spills that occurred before May 4, 1987, are to be decontaminated to requirements established at the discretion of the EPA.	PCBs are known to have been used at the Hanford Site and might be present in waste units and/or might have been released to the environment. TSCA requirements for remediation, treatment, and disposal of PCBs are applicable in developing response actions if the PCBs are present at regulated levels.
Guidance on Remedial Actions for Superfund Sites with PCB Contamination, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response	This document provides guidance for evaluating and selecting a remedy for sites contaminated with PCBs. The guidance presents a range of preliminary remediation goals for the cleanup of PCB-contaminated sites that are protective of human health and intended to meet the goals of the NCP and TSCA. EPA guidance notes that in selecting a response action under CERCLA, cleanup levels and disposal methods should be selected based on the form and concentration found at the site.	PCBs might be present at CERCLA waste sites at the Hanford Site.

Table B-1. Federal Laws, Regulations, and DOE Orders.

Citation	Requirement	Application
Clean Air Act of 1977, as amended 42 USC 7401, et seq.		
National Ambient Air Quality Standards, 40 CFR 50	Requirements of these regulations are applicable to airborne releases of criteria pollutants specified under the statute. Specific release limits for particulates are set at 50 $\mu g/m^3$ annually or 150 $\mu g/m^3$ per 24-hour period.	Applicable to airborne releases of criteria pollutants that might be generated during assessment or response actions.
Ambient Air Quality Monitoring, 40 CFR 58	This regulation presents the criteria and requirements for ambient air quality monitoring and reporting for local air pollution control agencies and operators of new sources of air pollutants.	Applicable to assessment or response actions that meet the regulatory definition of a new source. Also, these requirements may be considered relevant and appropriate to response actions that have the potential to emit air contaminants, even if they are not a new source.
Standards of Performance for New Stationary Sources, 40 CFR 60	These requirements provide standards for new stationary sources or modifications of existing sources.	Applicable if assessment or response actions include stationary sources.
National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR 61	40 CFR 61 provides general requirements and listings for actions that will generate regulated emissions at a regulated facility.	These requirements are applicable to assessment or response actions that release air emissions into unrestricted areas.
Subpart H, National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities, 40 CFR 61	Subpart H sets emissions limits to ambient air from the entire facility, not to exceed an amount that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr. The definition of "facility" for the Hanford Site includes all buildings, structures, and operations collectively as one contiguous site. Radionuclide emission from stacks shall be monitored and effective dose equivalent values to members of the public calculated.	These requirements are applicable to assessment and response actions that have the potential to release air emissions to unrestricted areas.
National Emission Standards for Asbestos, Standard for Demolition and Renovation, 40 CFR 61.145 – 150	This section specifies that facilities are to be inspected for the presence of asbestos prior to demolition. The standard defines regulated asbestos-containing materials and establishes removal requirements based on the quantity present and handling requirements. These requirements also specify handling and disposal requirements for regulated sources having the potential to emit asbestos. Specifically, no visible emissions are allowed during handling, packaging, and transport of asbestos-containing materials.	These requirements are applicable if response actions require demolition of buildings or structures containing regulated asbestos-containing materials.
Hazardous Materials Transportation Act, 49 USC 1801, et seq.		
Hazardous Materials Regulation, 49 CFR 171	These requirements state that no person may offer to accept hazardous material for transportation in commerce unless the material is properly classed, described, packaged, marked, labeled, and in condition for shipment.	These requirements are applicable to hazardous material generated during assessment or response actions, which is sent offsite for disposal.
Hazardous Materials Tables, Hazardous Materials Communications Requirements, and Emergency Response Information Requirements, 49 CFR 172	Tables are used to identify requirements for labeling, packaging, and transportation based on categories of waste types. Small quantities of radioactive wastes are not subject to the requirements of the standard if activity levels are below limits established in paragraph 173.421, 173.422, or 173.424. Specific performance requirements are established for packages used for shipping and transport of hazardous materials.	These requirements are applicable if hazardous materials are transported offsite during assessment or response actions. In the event of a discharge of hazardous waste during transportation from the treatment facility to the disposal facility, this section is applicable.

Table B-1. Federal Laws, Regulations, and DOE Orders.

Citation	Requirement	Application
Executive Order 12856, Federal Compliance with Right- to-Know Laws and Pollution Prevention Requirements	Requires that federal agencies will comply with Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA) and the Pollution Prevention Act of 1990 (PPA) to the extent that private entities would. The EO incorporates, by reference, all implementing regulations of EPCRA and the PPA. EPCRA requires tracking and reporting information on the storage, use, and release of extremely hazardous substances, hazardous substances, listed chemicals, and toxic chemicals to inform the public about the presence of such hazards in their community and to provide emergency planners and emergency response organizations with information needed to provide appropriate response to potential emergencies at the facilities. The PPA requires entities to implement practices that reduce or eliminate the creation of pollutants through increased efficiency in the use of raw materials, energy, water, or other resources; or protection of natural resources by conservation.	Applicable to federal agencies that either own or operate a "facility" as that term is defined in section 329(4) of EPCRA if such facility meets the threshold requirements set forth in EPCRA. Hanford meets the definition and threshold requirements.
DOE 1998, Draft Hanford Remedial Action Environmental Impact Statement, DOE/RL-98-X	The draft Hanford Remedial Action EIS will define land use decisions for the Hanford Site.	Land use and associated exposure scenarios are important in assessing risk and determining appropriate response actions.
National Historic Preservation Act of 1966, 16 USC 470	Requires that historically significant properties be protected. The act requires that agencies undertaking projects must evaluate impacts to properties listed on or eligible for inclusion in the National Register of Historic Places. An eligibility determination provides a site with the same level of protection as a site listed on the National Register of Historic Places. The regulations implementing the act require that the lead agency for a project identify, evaluate, and determine the effects of the project on any cultural resource sites that may be within the area impacted by the project. The implementing regulations require that negative impacts be resolved.	This law is applicable to assessment or response actions that could impact any of the various buildings/ structures at the Hanford Site that are eligible for the National Register.
Archeological and Historic Preservation Act, 16 USC 469a	Requires that actions conducted at the site must not cause the loss of any archeological and historic data. This act mandates preservation of the data and does not require protection of the actual facility. Where a site is determined to be eligible for the National Register and mitigation is unavailable, artifacts and data will be recovered and preserved prior to commencement of the action.	Archeological and historic sites have been identified at the Hanford Site, and therefore these requirements are applicable to activities that might disturb these sites.
Endangered Species Act of 1973, 16 USC 1531, et seq.	This act prohibits federal agencies from jeopardizing threatened or endangered species or adversely modifying habitats essential to their survival. If waste site remediation is within sensitive habitat or buffer zones surrounding threatened or endangered species, mitigation measures must be taken to protect these resources.	The Endangered Species Act of 1973 would be considered applicable if threatened or endangered species are identified in areas covered by the assessment. Their presence could dictate the approach to assessment or response actions that may be necessary.

Table B-1. Federal Laws, Regulations, and DOE Orders.		
Citation	Requirement	Application

ACL = alternate concentration level
ALARA = as low as reasonably achievable
CAMU = corrective action management unit
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
DCG = derived concentration guide
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
HCRL = Hanford Cultural Resources Laboratory
MCL = maximum contaminant level
MCLG = maximum contaminant level goal
NESHAP = National Emission Standards for Hazardous Air Pollutants
NCP = National Oil and Hazardous Substance Contingency Plan
NEPA = National Environmental Policy Act
NPDES = National Pollutant Discharge Elimination System
NRC = U.S. Nuclear Regulatory Commission
PCB = polychlorinated biphenyls
RCRA = *Resource Conservation and Recovery Act*
SDWA = Safe Drinking Water Act
TBC = to be considered
TSCA = Toxic Substance Control Act.

Table B-2. State of Washington Laws and Regulations

ARAR Citation	Requirement	Application
Hazardous Waste Clean Up/Model Toxics Control Act, Ch. 70.105D RCW		
Model Toxics Control Act, WAC 173-340-700	Establishes a process and requirements for cleanup of contaminated sites in the state. MTCA regulations have been authorized for use in implementing RCRA corrective action in the state. Specifies that all cleanup actions be protective of human health; comply with all applicable state and federal regulations; and provide for compliance monitoring. Identifies the methods used to develop cleanup standards and their use in selection of a cleanup action. Specifies cleanup goals, which implement the strictest federal or state cleanup criteria. In addition to meeting requirements of other regulations, MTCA uses three basic methods for establishing cleanup levels. These methods may be used to identify cleanup standards for groundwater, surface water, soils, and protection of air quality. Cleanup levels for soils may be calculated using Method A – routine; Method B - standard method; and Method C – conditional standards. MCLs, MCLGs, and secondary drinking water standards are identified in the regulation as groundwater cleanup criteria.	Requirements of MTCA are applicable to RCRA corrective action sites at the Hanford Site and relevant and appropriate for other Hanford waste sites (e.g., CERCLA sites). State requirements that are not authorized through a federal program, such as MTCA, are not directly applicable to federal facilities.
Hazardous Waste Management Act, 70.105 RCW		
Dangerous Waste Regulations, WAC 173-303	Establishes the design, operation, and monitoring requirements for managing dangerous waste.	Dangerous waste is present in Hanford Site waste units and might be generated during assessment or response actions. Sections of this chapter are applicable to dangerous waste management activities and may be relevant and appropriate in certain situations even when they are not applicable. Key sections are discussed below.
Designation of Waste, WAC 173-303-070 through 110	Establishes the methods and procedures to determine if solid waste requires management as dangerous waste.	The requirements of this section are applicable because dangerous waste might be generated.
Land Disposal Restrictions, WAC 173-303-140	Identifies dangerous wastes that are restricted from land disposal and describes requirements for state-only restricted wastes; defines the circumstances under which a prohibited waste may be disposed.	Applicable to the disposal of restricted wastes.
Spills and Discharges into the Environment, WAC 173-303-145	Sets forth the requirements that apply when any dangerous waste or hazardous substance is intentionally or accidentally spilled or discharged into the environment such that human health and the environment are threatened, regardless of the quantity of dangerous waste or hazardous substance.	Applicable should dangerous waste or hazardous substances be spilled or discharged into the environment.
Requirements for Generators of Dangerous Waste, WAC 173-303-170 through 230	Requirements defined under this section include specific levels of training and emergency preparedness.	Applicable to actions performed at the site if dangerous waste is generated.

Table B-2. State of Washington Laws and Regulations

ARAR Citation	Requirement	Application
General Requirements for Dangerous Waste Management Facilities, WAC 173-303-280 through 395	General requirements include siting standards, training, emergency preparedness, security, inspections, contingency planning, waste analysis, and management of containers.	Applicable to actions that include treatment, storage, or disposal of designated dangerous waste.
Treatment, Storage, and Disposal Facility Requirements, WAC 173-303-600 through 695	Specifies closure and post-closure standards (which require compliance with MTCA cleanup levels), groundwater monitoring requirements, corrective action management unit/temporary unit requirements, air emission standards for process vents and equipment leaks, and specific unit requirements for containers, tanks, surface impoundments, land treatment units, waste piles, landfills, incinerators, drip pads, miscellaneous units, and containment buildings.	Applicable because permitted TSD units are present and/or assessment or remediation wastes may be managed in units that are TSDs.
Releases from regulated units, WAC 173-303-645	Establishes groundwater protection standards for releases to groundwater from dangerous waste management units.	The standard is applicable because TSD units are present.
Solid Waste Management, Recovery and Recycling Act, Ch. 70.95 RCW		
Minimum Functional Standards for Solid Waste Handling, WAC 173-304	These standards establish requirements to be met for the management of solid waste. Solid waste controlled by this Act includes garbage, industrial waste, construction waste, and ashes. Requirements for containerized storage, collection, transportation, treatment, and disposal of solid waste are included. These standards set groundwater MCLs at the same levels as the state drinking water standards.	These regulations are applicable when solid waste is generated during assessment or response actions, and may be relevant and appropriate to existing solid waste facilities at the Hanford Site.
Water Pollution Control/Water Resource Act of 1971, Ch. 90.48 RCW/Ch.90.54 RCW		
Surface Water Quality Standards, WAC 173-201A	These standards set water quality standards at levels protective of aquatic life.	Groundwater from the Hanford Site discharges to the Columbia River; therefore, surface water quality criteria established under this chapter are applicable in assessing risk and response actions.
Protection of Upper Aquifer Zones, WAC 173-154	This regulation directs Ecology to provide for protection of upper aquifers and upper aquifer zones to avoid depletions, excessive water level declines, or reductions in water quality.	This regulation is not applicable because it establishes the policy and program for Ecology. However, the regulation is relevant and appropriate because protection of the aquifer from adverse impacts caused by waste management units is a primary goal.

Table B-2. State of Washington Laws and Regulations

ARAR Citation	Requirement	Application
State Waste Discharge Program, WAC 173-216	The regulation establishes requirements for industrial and commercial operations that discharge to the groundwater, surface waters, or municipal sewerage systems. Specific discharges prohibited under the program are identified. The intent of the regulation is to maintain the highest possible standards, and the law requires the use of all known available and reasonable methods to prevent and control the discharge of wastes into the waters of the state.	Requirements of this program are applicable to assessment or response actions that include discharges to the ground.
Department of Health Standards for Public Water Supplies, WAC 246-290	The rule established under WAC 246-290 defines the regulatory requirements necessary to protect consumers using public drinking water supplies. The rules are intended to conform with the federal SDWA, as amended. WAC 246-290-310 establishes MCLs that define the water quality requirements for public water supplies. WAC 246-290-310 establishes both primary and secondary MCLs and identifies that enforcement of the primary standards is the Department of Health's first priority.	The requirements of WAC 246-290-310 are relevant and appropriate because the groundwater at the Hanford Site is classified as a potential future source of drinking water , based on the State classification strategy.
State Radiation Protection Requirements, Ch. 70.98 RCW		
Radiation Protection Standards, WAC 246-221	Establishes annual average concentration limits for radionuclides in gaseous and liquid effluents released to unrestricted areas from licensed nuclear facilities. Occupational dose to adults and minors are set in these requirements. Dose limits that individual members of the public may receive in unrestricted areas from external sources are also set. The standard identifies the methods required to demonstrate compliance and provides derived air concentration and annual limit on uptake values that may be used to determine an individual's occupational dose. The standard specifies requirements for monitoring personnel exposure for both external and internal exposure.	This regulation is not strictly applicable because the Hanford Site does not have licensed nuclear facilities; however, it might be relevant and appropriate because it establishes standards for acceptable levels of exposure to radiation.
Radioactive Waste-Licensing Land Disposal, WAC 246-250	Establishes the procedures, criteria, and conditions for licensing of low-level radioactive waste land disposal facilities. This section presents specific levels of radiation protection and technical requirements for land disposal of radioactive waste.	This regulation is not strictly applicable because the Hanford Site does not have licensed disposal facilities; however, it might be relevant and appropriate to the assessment if response actions allow radioactive waste to remain on site.

Table B-2. State of Washington Laws and Regulations

ARAR Citation	Requirement	Application
Washington Clean Air Act, Ch. 70.94 RCW and Ch. 43.21A RCW		
General Regulations for Air Pollution, WAC 173-400	The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. This section requires that all emission units use reasonably available control technology, which may be determined for some source categories to be more stringent than the emission limitations listed in this chapter. The regulation requires that source testing and monitoring be performed. A new source would include any process or source that may increase emissions or ambient air concentration of any contaminant for which federal or state ambient or emission standards have been established.	Requirements of this standard are applicable to assessment and response actions that could result in the emission of hazardous air pollutants.
Controls for New Sources of Air Pollution, WAC 173-460	This standard requires that new sources of air emissions provide emission estimates for toxic air contaminants listed in the regulation. The standard requires that emissions be quantified and used in risk modeling to evaluate ambient impacts and to establish acceptable source impact levels. The standard establishes three major requirements for new sources of air pollutants: use of best available control technology; quantification of toxic emissions; and demonstration that human health is protected.	The standard is applicable to assessment and response actions where contaminants identified as toxic air pollutants are present and air emissions might be generated.
Ambient Air Quality Standards for Particulate Matter, WAC 173-470	These requirements set maximum acceptable levels for particulate matter in the ambient air and the 24-hour ambient air concentration standard for particles less than 10 μm in diameter (PM_{10}). The section defines standards for particle fallout in industrial, commercial, and residential areas. Alternate levels are set for areas where natural dust levels are high.	These requirements are applicable to assessment and response actions (e.g., drilling) that might emit particulate matter to the air.
Ambient Air Quality Standards and Emission Limits for Radionuclides, WAC 173-480	These requirements establish that the most stringent federal or state ambient air quality standard for radionuclides are enforced. The requirements define the maximum allowable level for radionuclides in the ambient air, which shall not cause a maximum accumulated dose equivalent of 25 mrem/yr to the whole body or 75 mrem/yr to any critical organ. However, ambient air standards under 40 CFR 61 Subparts H and I are not to exceed amounts that result in an effective dose equivalent of 10 mrem/yr to any member of the public. Emission standards for new and modified emission units shall utilize best available radionuclide control technology.	Requirements of this standard are applicable to assessment and response actions that might emit radionuclides to the air.

Table B-2. State of Washington Laws and Regulations		
ARAR Citation	**Requirement**	**Application**
Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOC), WAC 173-490	This chapter establishes technically feasible and attainable standards for sources emitting volatile organic compounds.	This regulation is applicable if assessment or response actions will result in airborne emissions of volatile organic compound.
Radiation Protection - Air Emissions, WAC 246-247	This regulation promulgates air-emission limits for airborne radionuclide emissions as defined in WAC 173-480 and 40 CFR 61, Subparts H and I. The ambient air standards under WAC 173-480 require that the most stringent standard be enforced. Ambient air standards under 40 CFR 61, Subparts H and I, are not to exceed amounts that result in an effective dose equivalent of 10 mrem/yr to any member of the public. The ambient standard in WAC 173-480 specifies that emission of radionuclides to the air must not cause a dose equivalent of 25 mrem/yr to the whole body or 75 mrem/yr to any critical organ.	This regulation is applicable to any assessment or response actions that would result in airborne emissions of radionuclides.
Radiation Protection at Uranium and Thorium Milling Operations, WAC 246-252	Radium-226 concentrations are required to be less than 5 pCi/g, averaged over the upper 15 cm, and not more than 15 pCi/g averaged over any 15-cm interval deeper than 15 cm from the surface. Groundwater protection standards established for gross alpha excluding radon and uranium are set at 15 pCi/L, and for combined radium-226 and radium-228 not to exceed 5 pCi/L.	This regulation is not strictly applicable because the Hanford Site does not have uranium or thorium milling operations; however, it is relevant and appropriate because it contains specific soil cleanup limits for radium-226 and radium-228 and groundwater protection limits.
Department of Game Procedures, WAC 232-012	This standard defines the requirements that the Department of Game must take to protect endangered or threatened wildlife.	These requirements may be applicable if endangered or threatened wildlife are identified in areas affected by assessment or response actions. The requirements of this chapter should be evaluated on an activity-specific basis.
National Area Preserves, RCW 79.70		
Washington Natural Heritage Program	The Washington State Natural Heritage Program is authorized under RCW 79.70, Natural Area Preserves, and serves as an advisory council to the Washington State Department of Natural Resources, Fish and Wildlife, the Parks and Recreation Commission, and other state agencies managing state-owned land or natural resources. The list of state endangered, threatened, and sensitive plants developed by the program, along with program-recommended levels of protection, are to be used to assist resource managers in determining which species of concern occur in their areas and recommend protection. The designations provided to plants by the Washington State Natural Heritage program are advisory and do not specify a regulatory level of protection.	The requirements of the Natural Heritage Program provide guidance that could affect assessment or response actions in areas where threatened or endangered plant species have been identified.

Table B-2. State of Washington Laws and Regulations

ARAR Citation	Requirement	Application
Water Well Construction, Ch. 18.104 RCW		
Minimum Standards for Construction and Maintenance of Water Wells, WAC 173-160	These requirements establish minimum standards for design, construction, capping, and sealing of all wells. The requirements set additional requirements, including disinfection of equipment, decommissioning of wells, and quality of drilling water.	These requirements are applicable because assessment or response actions could include construction of wells for groundwater extraction, monitoring, injection of treated groundwater, or resource protection, or geotechnical borings.
Rules and Regulations Governing the Licensing of Well Contractors and Operators, WAC 173-162	This regulation establishes training standards for well contractors and operators.	This regulation is relevant and appropriate because assessment or response actions could involve groundwater well installation or construction of geotechnical borings.
State Environmental Policy Act, Chapter 43.21C RCW		
SEPA Rules, WAC 197-11	These requirements establish compliance with the State Environmental Policy Act.	These requirements are applicable.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
Ecology = Washington Department of Ecology
MCL = maximum contaminant level
MCLG = maximum contaminant level goal
MTCA = Model Toxics Control Act
NPDES = National Pollutant Discharge Elimination System
RCRA = Resource Conservation and Recovery Act
RCW = Revised Code of Washington
SEPA = State Environmental Policy Act
SDWA = Safe Drinking Water Act
TBC = to be considered
TSD = treatment, storage, and disposal
VOC = Volatile Organic Compounds
WAC = Washington Administrative Code.

APPENDIX C

SUMMARY OF EXTERNAL REVIEWS AND RECOMMENDATIONS

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

Bechtel Hanford, Inc., Richland, Washington

BHI-00061	Report	9/1/94	Freeman-Pollard, J.R., J.A.Caggiano, S.J. Trent, and EBASCO

Title: Engineering Evaluation of the GAO/RCED-89-157 Audit Finding: Tank 241-T-106 Vadose Zone Investigation

Issues/Concerns: The GAO stated that "DOE does not collect sufficient data to adequately trace the migration of the leaks (from single-shelled tanks--ed.) through the soils, and studies predicting the eventual environmental impact of tank leaks do not provide convincing support for DOE's conclusion that the impact will be low or nonexistent" (p. ES-1).

Recommendations: · Upon completion of the 1993 investigation, it is recommended that the following actions occur (p. ES-2): 1. The Ringold Unit E should be a primary target for future investigations, as the downward migration of mobile contaminants potentially present in this unit could contaminate groundwater in the future. 2 . . . numerical models should be used to estimate migration rates of contaminants and moisture flux in the vadose zone. 3. An effort should be made to correlate responses from the radionuclide logging system to responses obtained in the same boreholes by the 1979 gamma energy analyses.

CCN-004891	IOM	11/4/94	Forsen, H.K.

Title: Results of Groundwater Challenge Group

Issues/Concerns: 1) (Regarding excessive level of detail in TPA imposed by regulators--ed.) In several cases, the overly prescriptive "guidelines" do not appear to be technically sound and we encourage the contractors and the DOE to challenge such initiatives. For example, the installation of small pump and treat units in the midst of large groundwater plumes to create the perception of progress while injecting into the center of the plume and spreading is indefensible (p. 2). 2)· . . the use of insufficient numbers of wells and/or the use of inappropriate wells to avoid the high cost of installing new wells (p. 3).

Recommendations: 1) BHI should seek the support of DOE-RL to revisit the TPA and redefine the decision-making process to better accommodate technical practicability (p. 3). 2) . . the success of the resonant sonic drilling technology should lead to much lower drilling costs and shorter installation times . . . Site management should move quickly to find a middle ground for the (sonic drilling--ed.) contractor . . . (p. 3).

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

Confederated Tribes and Bands of the Yakama Indian Nation, Toppenish, Washington

YIN-2/23/98a Letter 2/23/98 Jim, R.

Title: Subj: Followup to Hanford visit by Robert Alvarez, DOE-HQ

Issues/Concerns: Hanford's latest politically correct science initiative, the Integrated Ground Water/Vadose Zone Project (GW/VZ), seems disappointing so far. As the attached letter to Secretary Moniz indicates, we see an absence of thinking about purpose, scope, or integration of subordinate analysis efforts.

Recommendations: I have attached a figure from the CRCIA to help make the point that there is no escaping the need for an overarching analysis. GW/VZ can only be, at best, a subordinate element of that border analysis.

YIN-2/23/98b Letter 2/23/98 Yallup, W. F.

Title: Subj: Followup to Hanford visit by Ernest J. Moniz, DOE-HQ

Issues/Concerns: We sincerely hope there is more science than hype in the GW/VZ concept.... Currently we see little to no grasp among the leadership or staff of an explicit purpose for the Project, a vague to non-existent definition of its scope, and such a poor understanding of "integration" as to render impossible any definition of interfaces between source term, transport, exposure and impact.

Recommendations: A credible Hanford regional effects analysis must have reliable travel time and concentration information from the GW/VZ Project, but the GW/VZ Project cannot become and acceptable credible regional effects analysis.

YIN-9/23/97 Letter 9/23/97 Jim, R.

Title: Subj: Work-in-progress presentation of the Composite Analysis effort

Issues/Concerns: With respect to the CRCIA, we await DOE's response to the virtually unanimous call at the Salt Lake City Workout for full funding of this analysis ($23.8M across FY 98, 99, and 00). It is important to note that the policy level speakers at the table who are insisting the CRCIA be funded did so with full awareness of the funding shortfall and of DOE's response to the TPA milestone regarding the CRCIA. The reasoning in the milestone letter simply is not valid.

Recommendations: [...not specified]

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

Confederated Tribes of the Umatilla Indian Reservation

UIR-9/3/97	Letter	9/3/97	Minthorn, A.

Title: Subj: Invitation to Visit the Umatilla Indian Reservation

Issues/Concerns: 1) DOE/RL is attempting to avoid its duty to consult with the tribes on a government-to-government basis. 2) DOE/RL is attempting to avoid implementing the recommendation of the CRCIA team that the scope of the CRCIA should be site-wide and cross-program. 3) DOE/RL is placing excessive emphasis on developing new models, without first defining the Hanford Site's endstate conditions, contrary to the recommendations of the CRCIA team. 4) DOE/RL is attempting to avoid complying with the recommendations of the CRCIA team and the public that the CRCIA project be fully funded. 5) As the community receiving the greatest risk from Hanford contamination, the tribes must continue to perform a central role in the estimation of risk associated with Hanford Site activities.

Recommendations: [...not specified]

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*
Hanford Advisory Board			
HAB61-12/5/96	Letter	12/5/96	Reeves, M.B.

Title: Subj: Columbia River Comprehensive Impact Assessment

Issues/Concerns: 1) ...major potential impacts to the River could occur in the future when additional groundwater contaminant plumes on the Hanford Site reach the River. 2) ...there is a need for a consistent approach to performance and risk assessments across the DOE complex. 3) ...the Board sees a need for better sitewide coordination of and consistency between the risk and impact assessment approaches used for all the projects and programs at the Hanford Site. 4)...there is a need for an integrated approach that evaluates that cumulative impacts of the various cleanup alternatives for the Hanford Site.

Recommendations: 1) ...the Board recommends that funding should be provided for continuing Steering Committee work on CRCIA Phase 2, particularly in FY-97, to develop a baseline risk assessment methodology and to provide better sitewide coordination of risk and impact assessments among the projects and programs at Hanford. 2) To further facilitate this coordination, the Board recommends that coordination of the activities of the CRCIA Steering Committee should be elevated to the Deputy Manager.

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

Hanford Natural Resource Trustee Council

NRT-7/15/97a	Letter	7/15/97	Tallent, G.

Title: Subj: Screening Assessment and Requirements for a Comprehensive Assessment (DOE/RL-96-16) review and comment

Issues/Concerns: ...there is a need for a comprehensive estimate of river-related human health and ecological risks, and an evaluation of the sustainability of the river ecosystem. That information will serve both Hanford Site decision makers and the people and communities affected by cleanup decisions.

Recommendations: 1) We support continued study of Hanford contaminants and their impact on the Columbia River. Data and information gathered through such studies,...can support both future impact assessment and the NRTC. 2) ...we must work together to ensure that each of our efforts at data collection an studies will be mutually beneficial. While the NRTC does not believe that the structure envisioned in appendix II_D of the CRCIA will accomplish that purpose, we look forward to meeting with the CRCIA team in the future to better define our respective roles.

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

National Academy of Sciences, Washington, D.C.

NRC-1/1/96	Report	1/1/96	National Research Council

Title: Barriers to Science: Technical Management of the Department of Energy Environmental Remediation Program

Issues/Concerns: 1) The committee has concluded that a fundamental obstacle to progress (regarding environmental remediation--ed.) is not technical, but organizational . . . the efforts of fine people to overcome difficult scientific and engineering challenges have been stymied by the organizational structure in which they work (p. 19). 2) A variety of problems (associated with environmental remediation of the defense radioactive waste sites managed by the Department of Energy--ed.) have been noted: (a) Planning that is driven by existing organizational structures, rather than by problems to be solved. (b) Commitments that are made without adequate consideration of technical feasibility, cost, and schedule. (c) An inability to look at more than one alternative at a time. (d) Priorities that are driven by narrow interpretations of regulations rather than by the regulations' purpose of protecting public health and the environment. (e) Production of documents as an end to itself, rather than as a means to achieve a goal. (f) Lack of organizational coordination. (g) A "not-invented-here" syndrome at some individual sites.

Recommendations: A full solution to the problem (organization barriers to environmental remediation--ed.) as described requires change not only by DOE, but also by Congress, involved states, and the public. Solving this problem is in large part a matter of technical management, not of science and engineering per se (p. 19).

NRC-9/6/96	Report	9/6/96	National Research Council

Title: The Hanford Tanks: Environmental Impacts and Policy Choices

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

Issues/Concerns: 1) A phased decision strategy that considers multiple alternatives involving both ex situ and in situ disposal is needed, rather than a phased implementation plan for a single alternative as DOE and the Washington State Department of Ecology propose in the Draft EIS (for Hanford Site Tank Waste Remediation System--ed.) (p. 2). 2) Significant uncertainties exist that limit the ability of DOE to define and characterize disposal alternatives (for Hanford underground storage tanks--ed.) and, hence, to select a final disposal alternative for all of the tanks' wastes (p. 2). 3) An important component of a long-term commitment to remediating the single-shell tanks at the Hanford Site is an adequate understanding of the nature of the present contents in the tanks and the extent to which the soil and ground water beneath the tank farms have been contaminated (p. 27).

Recommendations: 1) A comprehensive strategy of environmental monitoring and risk surveillance should be an essential component of the phased approach. The goal of this strategy should be to assure that public health and the environment are adequately protected during implementation of the overall remediation program (p. 7). 2) (Topic: . . . reduce uncertainties associated with the characteristics of the waste inside and outside of the tanks--ed.) A better understanding of what has already leaked and how rapidly it is moving toward the ground water is needed for assessing risks . . . The mechanisms and rates of migration of cesium and other radionuclides originating from the tank farms and from other waste disposal facilities at the Hanford Site need to be better understood (p. 51). 3) The (alternatives--ed.) analysis (in the Draft EIS--ed.) should also give more details about the levels of existing contamination in the soil and ground water under the tanks and estimates of long-term impacts of such contamination under baseline conditions (p. 56).

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

Nez Perce Environmental Restoration & Waste Management

NPT-10/10/97	Letter	10/10/9	Powaukee, D.

Title: Subj: Future Nez Perce Tribe ERWM Columbia River Comprehensive Impact Assessment (CRCIA) Involvement, and the Milestone M-15-80-B Letter

Issues/Concerns: ...the CRCIA will no longer exist and will be taken over by forums such as the Hanford Advisory Board (HAB). This means DOE-RL is not going to honor the commitment made to us by DOE headquarters.

Recommendations: DOE should officially accomplish a transfer of tribal consultation from the CRCIA to the forum to follow...ERWM suggests that such a process may be Hanford sitewide rather than attached to the Columbia River.

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*
Oregon Department of Human Resources			
OHD-7/14/97	Letter	7/14/97	Hall, E.

Title: Subj: CRCIA information meeting followup

Issues/Concerns: [...not specifically identified]

Recommendations: 1) We strongly urge the CRCIA to maximuze its efforts to characterize the risks from the Hanford reservation and plan remedial actions to preclude additional contamination of the vadose zone. 2) Elimination of contaminants to the river will be the most effective strategy to protect the river and protect public health and safety in this vital area of the Columbia River. 3) ...further detailed study of the future potential human health effects may be more appropriate after characterization of contamination risks and immediate preventive clean up are completed on the Hanford site.

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

U.S. Department of Energy, Richland, Washington

DOE/RL-97-49	Report	4/1/97	Conaway, J.G., R.J. Luxamoore, J.M. Matusek, and R.O. Patt

Title: Tank Waste Remediation System Vadose Zone Contamination Issue: Independent Expert Panel Status Report

Issues/Concerns: 1) The Vadose Zone Characterization Program appears to be caught between conflicting pressures and organization mandates, some imposed from outside DOE-RL and some self-imposed (p. P-1). 2) . . .whether high apparent concentrations of cesium-137 discovered deep in the vadose zone, based on spectral gamma-ray borehole logging at the SX Tank Farm are indicative of contaminants moving as a broad plume through the formation or moving down the borehole itself (p. P-3). 3) . . . contaminant transport studies in the Hanford geology and other environments indicate the likely mode of transport is along preferential, vertical, possibly tortuous, pathways . . . flow tends to divide fairly quickly into fingers rather than moving as a broad plume (p. P-3). 4) As a result of this lack of information (on vadose zone contaminant transport--ed.) at Hanford, previous and ongoing modeling efforts are inadequate and based on arguable, unrealistic, and sometimes optimistic assumptions. The output of such models is entirely unreliable and best described by the old axiom: garbage in, garbage out (p. P-4).

Recommendations: 1) Numerous specific recommendations (pp. ES-4 through ES-6). 2) Clearly, to understand the distribution of contaminants in the groundwater, as well as in the vadose zone, it is necessary to characterize the vadose zone (p. P-3). 3) Characterization of the vadose zone is an essential step toward understanding contamination of the groundwater, assessing the resulting health risks, and defining the concomitant groundwater monitoring program necessary to verify risk assessments (p. P-3). 4) . . . the Expert Panel takes note of (and concurs with--ed.) the recently published findings of the National Academy of Science/National Research Council (regarding the TWRS Draft EIS--ed.) (p. P-4) . . . (see B: below--ed.) 5) One approach to providing cost-effective means of infusing new ideas is open competition for vadose zone modeling (p. P-8). 6) The vadose zone modeling efforts for tank farms appear particularly ripe for infusion of new approaches and new data. We strongly suggest that nationally known expertise . . . be sought in support of resolving these complex technical issues (p. P-8). 7) The Panel advocates as a general policy that objective and independent peer review be undertaken before initiating major phases of field investigations, laboratory research, and simulation modeling for the Vadose Zone Characterization Program (p. P-8).

Originating Organization/ Document Number	Type	Date	Author(s)

U.S. Department of Energy, Washington, D.C.

DOE-1/15/98 Report 1/15/98 Rudzinski, S.

Title: Review of the Federal Management of the Tank Waste Remediation System (TWRS) Project: Hanford Site, Washington

Issues/Concerns: 1) Current TWRS management processes for addressing safety and technical issues lack sufficient rigor to consistently detect, manage, and resolve issues for the program. 2) Processes for reviewing and resolving technical and safety comments are weak and have failed to address significant issues in several cases. 3) External credibility issues continue with the vadose zone program. Past management of the program (1980s through present) has contributed substantially to these problems. 4) Management problems identified in previous self-assessments persist.

Recommendations: 1) Develop and implement corrective actions to address the team's findings within established deadlines. 2) Increase the rigor of safety authorization documentation and the USQ process. 3) Implement a more open and disciplined internal and external comment resolution process. 4) Accelerate current site efforts to develop a process to resolve differences of professional opinion and pilot test the process before implementing it broadly. 5) Fully integrate the vadose zone, groundwater, and Hanford Tank Initiative programs. Establishe clear goals for the use of data among the programs and institute expert panel review of methodologies, modeling plans, and interpretation of results. 6) Improve communications of project and policy decisions to the staff and public. This will require the TWRS program to share information more openly and earlier than it has traditionally done. 7) Develop and implement a corrective action plan to address unresolved management problems from this report and previous studies.

DOE/EH-0139 Report 7/1/90 Department of Energy

Title: Tiger Team Assessment of the Hanford Site: Environmental, Safety, and Health Assessment of the Hanford Site

Issues/Concerns: 1) Current and past waste (primarily liquid effluent) disposal practices have contaminated and continue to contaminate the groundwater. A related concern is that currently the Site does not sufficiently understand the overall Site hydrogeology to guide remedial actions (p. ES-5). 2) Formal quality assurance programs for some activities are deficient to the point that the defensibility of data is questionable (p. ES-5). 3) The State of Oregon has raised a concern regarding the integrity of well seals for monitoring wells required by the Tri-Party Agreement (p. ES-6). 4) (Under "Root Causes") Management's ability to achieve ES&H (Environmental Health and Safety--ed.) goals is inhibited by inadequate monitoring, assessment, and corrective action implementation. Management's presence in the field is inadequate to fully understand field conditions and problems (p. ES-11).

Recommendations: 4) (Under "Root Causes") Management's ability to achieve ES&H (Environmental Health and Safety--ed.) goals is inhibited by inadequate monitoring, assessment, and corrective action implementation. Management's presence in the field is inadequate to fully understand field conditions and problems (p. ES-11).

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*
U.S. Environmental Protection Agency			
EPA-9/16/97	Letter	9/16/97	Wilson, M.

Title: Subj: Future Work Towards the Columbia River Comprehensive Impact Assessment (CRCIA)

Issues/Concerns: 1) The DOE proposes to conduct government-to-government consultation separate from stakeholder involvement (in the CRCIA-ed.) 2) A second concern is the (DOE's - ed.) lack of commitment to pursue the CRCIA as a sitewide cumulative assessment.

Recommendations: Future CRCIA activities should be coordinated at a management level adequate to ensure cross-programmatic funding and integration.

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*

U.S. General Accounting Office, Washington, D.C.

GAO/RCED-89-157 Report 7/18/89 General Accounting Office

Title: Nuclear Waste: DOE's Management of Single-Shell Tanks at Hanford, Washington

Issues/Concerns: 1) DOE has gathered extensive data about tank leaks, but its current monitoring efforts do not provide sufficient data to adequately trace the migration of the leaks or to fully assess their effects . . . better waste migration data can be obtained through expanded use of current monitoring methods and through adoption of new methods (p. 3). 2) DOE officials have stated that the environmental impact of the single-shell tank leaks will be low or nonexistent . . .we believe the studies do not provide conclusive evidence about the degree of environmental impact attributable to tank leaks . . . (the studies--ed.) did not project the impact on the Columbia River (p. 5).

Recommendations: To minimize the environmental effects of tank leaks on the surrounding soil and, eventually, on the groundwater... conduct a data-gathering program sufficient to assess the risks and extent of groundwater contamination from tank leaks of mobile, nonradioactive contaminants and mobile, long-lived radioactive substances (p. 10).

GAO/RCED-98-80 Report 3/1/98 General Accounting Office

Title: Nuclear Waste: Understanding of Waste Migration at Hanford is Inadequate for Key Decisions

Issues/Concerns: 1) DOE's past efforts have left the agency unable to answer basic questions about what radioactive and hazardous wastes are in the vadose zone at the Hanford Site, how quickly these wastes are migrating, the degree to which they might contaminate the underlying groundwater, and the risks of such contamination to current and future residents of the surrounding area. 2) DOE's proposal to inject water under pressure into wasste storage tanks to dissolve hardened wastes illustrates the weakness in the Department's current understanding of conditions in the vadose zone...Independent experts, however, have pointed out that the risks from additional leakage must be analyzed to determine if they are acceptable.

Recommendations: 1) We recommend that the Secretary of Energy develop a comprehensive vadose zone strategy for the Hanford Site that addresses cleaning up the high-level waste tank farms and the cribs, poinds, trenches, and other waste sites... 2) Address the importance of understanding conditions in the vadose zone to ongoing cleanup activities and future decisions on cleaning up the Hanford Site. Examples (a) covering tank farms with gravel; (b) slowing the removal of wastes from single-shell tanks, and (c) deciding whether to retrieve wastes from leaking single-shell tanks, and if so, how. 3) Identify steps to ensure the credibility of the process and the informaiton that is collected, such as review by stakeholders and subject matter experts. 4) Define leadership roles within DOE and its contractors. The overall leadership for this program should be clearly defined, with measureable performance goals and accountability for meeting the goals established at the outset. 5) We also recommend that the Secretary of Energy re-evaluate, as soon as better information is available on the behavior of wastes in the vadose zone, the Department's proposed strategy of removing additional wastes from single-shell tanks by injecting pressurized water into the tanks.

Originating Organization/ Document Number	*Type*	*Date*	*Author(s)*
Washington State Department of Ecology			
ECO-10/7/97a	Letter	10/7/97	Holland, D.

Title: Subj: Milestone M-15-80-B Submittal/Completion of the Columbia River Comprehensive Impact Assessment (CRCIA)

Issues/Concerns: Ecology's concerns relate to tribal and stakeholder involvement, technical approach, management approach, incompleteness of the referenced letter to fulfill the intent of milestone M-15-80-B, and a general lack of commitment to continuing the CRCIA process.

Recommendations: Ecology strongly supports the concept of a comprehensive impact assessment in accordance with CRCIA requirements, and continuing the successful process of integrating government-to-government consultation and stakeholder involvement. Ecology sees the need for a commitment to manage the assessment in a sitewide cross-programmatic manner and the need to resolve our mutual concerns in a timely manner.

ECO-2/13/97	Letter	2/13/97	Silver, D.

Title: Subj: HAB Consensus Advice #61 Concurrence

Issues/Concerns: [...not specifically identified]

Recommendations: 1) We support recommendations (HAB Consensus Advice #61 -ed.) that funding should be provided by the Department of Energy to allow the CRCIA Management Team to continue work on Phase 2 of the CRCIA during FY-97, and that this work should be coordinated across the projects and programs at Hanford. 2) ...in order to make appropriate remedial decisions in a site-wide context and responsive to stakeholder concers, there is a need to evaluate potential impacts to the Columbia River from future groundwater plumes with a systematic and integrated approach.

APPENDIX D

CURRENT CONDITIONS AND FUTURE EXPECTATIONS

APPENDIX D

Current Conditions and Future Expectations

This appendix provides background information that is necessary to establish the overall context for development of the Integration Project. The main topics presented are in this appendix are as follows:

- Current conditions of the Hanford Site with regard to the geographic setting, hydrogeologic framework, and contamination sources.
- Ongoing projects and activities at the Hanford Site that are relevant to contaminant characterization, mitigation, remediation, monitoring, and assessment.
- Expectations for the conduct and outcome of cleanup activities at the Hanford Site relative to stakeholder values for future site conditions and uses.

The Integration Project is a vehicle ensuring that work progresses effectively and efficiently toward stakeholder expectations of future site conditions.

D.1 CURRENT CONDITIONS

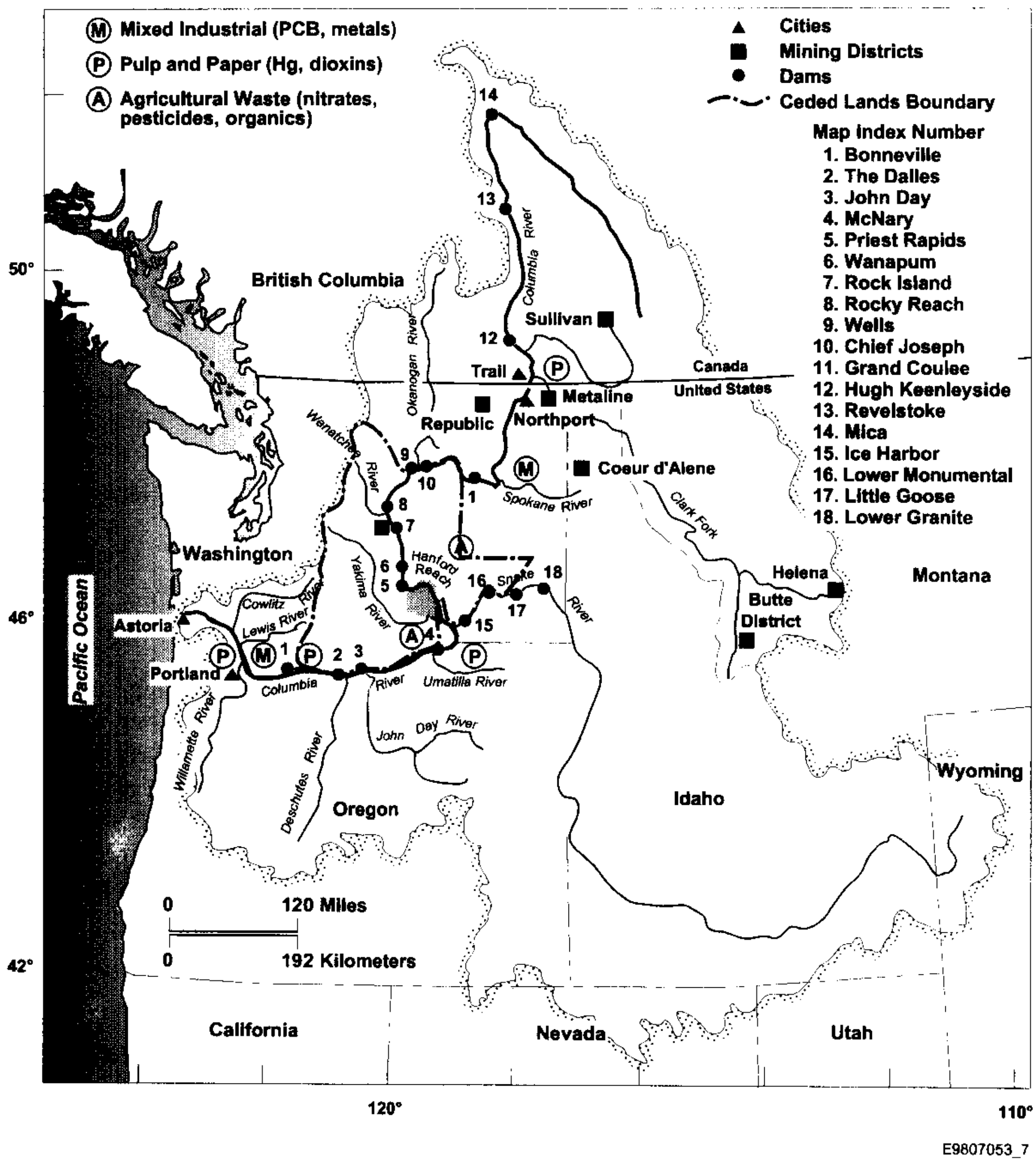
This section summarizes current information about the Hanford Site geographic setting, geohydrologic conditions and contaminant sources and distribution in soil, groundwater, and the Columbia River. The objective is to provide an overview of known and potential sources and processes controlling the transport and fate of contaminants originating from past and present Hanford Site activities. Non-Hanford Site sources of contamination in the Columbia River drainage basin are also mentioned, for added perspective. Key information sources that may be consulted for more comprehensive descriptions of the topics summarized in this section are identified in Section D.4.

D.1.1 Geographic Setting

The Hanford Site is located within a broad alluvium-filled depression in the folded basalt of the Columbia Basin. The original 560 mi^2 reserved for the Hanford Site is centrally located within the 17,000 mi^2 of ceded Native American lands (Treaty of 1855). The ceded lands extend north from near Bonneville Dam along the Columbia River to Spokane (Figure D-1).

Major industrial activities in the drainage basin include agriculture, mining, nuclear and hydroelectric power generation, aluminum and paper production (Figure D-1). These activities impact water quality (e.g., higher temperature and gas supersaturation due to the dams), and contribute to contaminant loading of the Columbia River both upstream and downstream of the

Figure D-1. Geographic Setting.



Hanford Site. Thus, the extent of the Hanford Site's current and future impact on the Columbia River should be viewed as but one of many impacts.

D.1.2 Hydrogeologic Conditions

Climatic, geologic, and hydrologic conditions control the transport of mobile contaminants from the Hanford Site to the Columbia River, and within the Columbia River system.

D.1.2.1 Climate

The Hanford Site is located in a shrub steppe ecosystem that is heavily influenced by the rain shadow effect of the Cascade Mountains. Annual average precipitation is approximately 16 cm/yr. Sagebrush and bunchgrass are the dominant natural plants. Under undisturbed or natural surface conditions, net drainage through the vadose zone is a small fraction of the average precipitation.

Most infiltration occurs during the winter months, when evapotranspiration is low. Significant infiltration occurs during snow melt events.

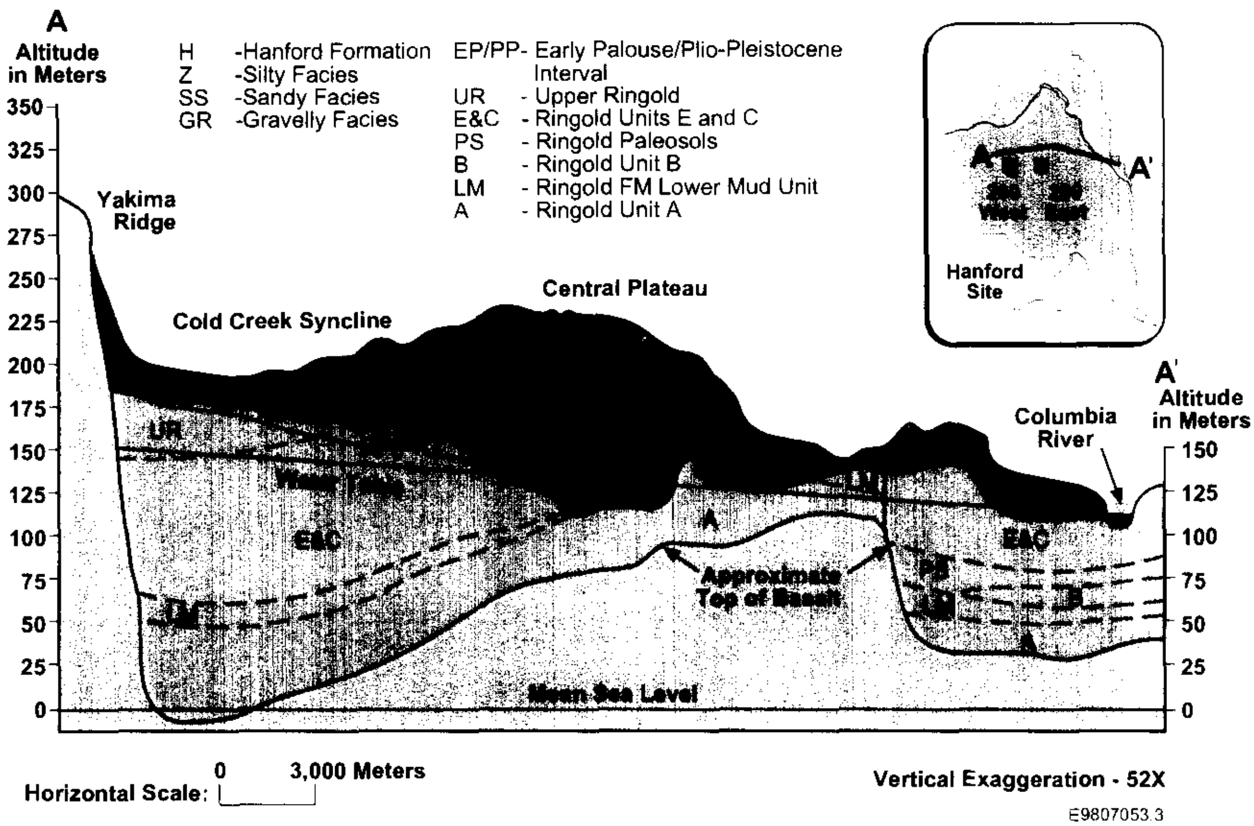
Strong westerly winds transport fine sand and particulates across the Hanford Site. Dry surface conditions and high velocity winds help disperse particle-bound surface contamination during construction or remediation activities, and provide a potential pathway for non-mobile or particle-bound contaminants to enter the Columbia River.

D.1.2.2 Geology

This section identifies the geologic conditions which control the direction and rate of groundwater flow and subsurface contaminant transport. Other published documents provide a more comprehensive and detailed description of the geology of the Central Plateau. These documents are listed in Section D.5.

Stratigraphy. Two sedimentary units overlie the basalt bedrock beneath the Hanford Site: the Ringold Formation and the Hanford formation. A geologic cross-section of the Hanford Site is shown in Figure D-2. Other stratigraphic units, such as the early "Palouse" soil and the Plio-Pleistocene unit, lie between the Hanford and Ringold formations in the western portion of the Central Plateau. The Ringold Formation, which is divided into several sub-units, represents mostly fluvial (river) and lacustrine (lake) deposits that formed along the ancestral Columbia and Snake River drainages ~3 to 8.5 million years ago. Sediments of the Ringold Formation range from coarse gravel to fine silt and clay. Deposition of the Hanford formation began between 1-2 million years ago, continued intermittently up to about 13,000 years B.P., and was associated with cataclysmic floods that burst periodically from ice-dammed lakes around the margins of the Columbia Plateau. Flood sediments consist of mostly loose, highly permeable, coarse gravel and sand in the center of the Pasco Basin, which grade laterally into a more-cohesive, low-permeability silt and fine sand towards the margins of the basin. Compared to the Hanford formation, the saturated hydraulic conductivities of Ringold deposits, with comparable texture, are at least an order of magnitude less, due to a higher degree of compaction and cementation in the Ringold Formation.

Figure D-2. Generalized Geological Cross Section of the Hanford Site.



The stratigraphy above the water table has a profound influence on the movement of moisture and contaminants through the soil column beneath many waste sites. Layers of fine-grained sediment slow the downward movement of water, resulting in "perched" water zones. This condition laterally expands the source area beyond the physical dimensions of a disposal facility, and may also influence the time required for contaminants to reach the water table. As a result, extended drainage periods may persist following termination of wastewater disposal operations.

The vadose and saturated zones within the 200 East Area are dominated by highly permeable facies of the Hanford formation. In contrast, the vadose zone in the 200 West Area includes the early "Palouse" soil and Plio-Pleistocene units, and occasionally the upper portion of the Ringold Formation, in addition to the overlying Hanford formation.

Where the fine-grained early "Palouse" soil and Plio-Pleistocene units are present, the downward percolation of moisture through the vadose zone can be slowed significantly, unless preferential vertical pathways are present. The saturated zone within the 200 West Area is dominated by alternating coarse and fine-grained facies of the Ringold Formation. Here, the uppermost unconfined aquifer is stratigraphically above a thick (several meters or more), laterally continuous aquitard, referred to as the Ringold Lower Mud unit. Below the Lower Mud unit lies the semiconfined aquifer system, where groundwater is contained within the basal portion of the Ringold Formation, as well as sedimentary interbeds between flows of Columbia River basalt. In general, these confined aquifers are isolated, except for hydraulic communication occurring along fractures or faults.

Vertical Features. In addition to faults, there are clastic dikes or vertical structures that cut across the sedimentary units. The dikes are approximately 5 to 25 cm thick, and occur as "walls" of polygons (or cells) that are typically 20 to 30 m across. Multiple interconnected cells appear in a honeycomb pattern when viewed from the air. This "patterned ground" is common in undisturbed areas at the 200 Area plateau. Surface water tends to travel downward more readily along dikes than through the horizontally bedded sediments.

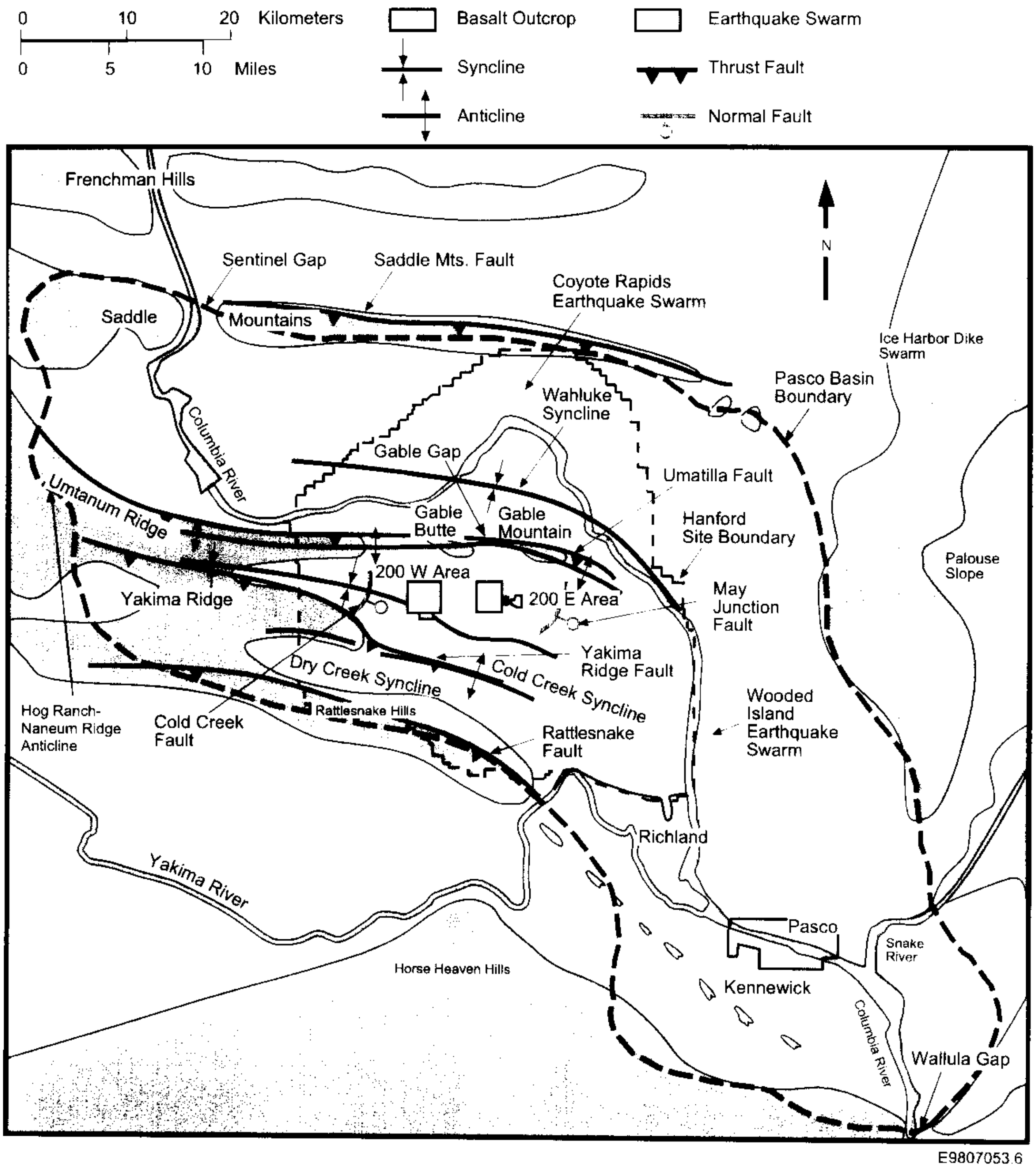
Geochemistry. The Hanford Site soils and sediments in the stratigraphic units described above are generally low in organic matter and contain relatively large amounts of calcium carbonate. Both groundwater and soil pH are slightly alkaline (pH ~8) due to the interaction of gaseous carbon dioxide, water, and calcium carbonate. Neutralization of acidic wastes (past-practice soil column disposal sites) by the calcium carbonate, and the slightly alkaline soil and groundwater, favor sorption or retention of heavy metals and transuranic radionuclides.

Exceptions include instances where complexing agents were present in the wastes (e.g., organic complexing agents in PFP liquid waste streams and in some single shell tanks). Mineralogy and grain size of the sediments also influence the nature and extent of contaminant-sediment interaction. For example, cesium-137 can be irreversibly bound by layer-silicate minerals (e.g., clays and micas) present in the finer-textured sediments. Additional discussion of the geochemical characteristics of Hanford Site groundwater, soils, and liquid waste chemistry can be found in Ames and Serne (1993) and Serne (et al:1998).

Seismicity. More than 1,000 earthquakes have occurred at, and in the vicinity of, the Hanford Site since 1980. Most of these occur in clusters and are termed "earthquake swarms." Two of the most active swarms are the Coyote Rapids swarm (near the 100-K and 100-N Areas) and the Wooded Island swarm (near the 300 Area ([Figure D-3]). Roughly 90% of the earthquakes in swarms have Richter magnitudes of 2 or less, with 75% of the events located at depths <4 km.

The earthquake record at the Hanford Site indicates that high subsurface stress conditions are being relieved as small earthquakes rather than building up over time. Knowledge of structural geology and the earthquake record formed the basis for a recent seismic hazard assessment of the Hanford Site. The seismic hazard assessment provides the basis for determining the design-basis ground motion for a given performance period or design life. Most industrial facilities are designed for a ~50-year life. However, if in-place stabilization is to be considered for a facility after its intended mission is over, then an extended performance period must be determined for its stabilization design. Continued seismic monitoring provides data to assess the seismic performance of a long-term facility. For example, seismic damage of a surface barrier that allows infiltration of surface water is a possible scenario for closure design considerations.

Figure D-3. Structural Geology Map of the Pasco Basin.



D.1.2.3 Hydrology

Groundwater generally moves from west to east across the Hanford Site (except where modified by local artificial recharge from Hanford Site operations). The total amount of groundwater discharging to the Columbia River from the Hanford Site (west of the river) is less than 50 cfs, or < 0.1% of the mean flow of the river.

Precipitation on basalt ridges is the principal source of natural groundwater recharge. The total recharge is uncertain, but Dry Creek and Cold Creek drainages contribute about 2 cfs. Subsurface recharge from basalt aquifers, as well as input from irrigation activities, may add to this amount. By comparison, one typical irrigation circle (~350 acres) applies water at the rate of about 1 cfs during the irrigation season. Vineyards and apple orchards in the Cold Creek valley withdraw water from the confined aquifer system at about 5 cfs, losing ~90% to evaporation.

Artificial recharge from the Hanford Site has declined to less than 20 cfs. During peak operations, approximately 50 cfs of artificial recharge occurred, primarily in the 200 Areas. The resulting groundwater "mounds" altered natural flow directions and increased northerly flow from the 200 Areas through Gable Gap (Figure D-4). As groundwater mounds dissipate, the flow direction may be more west to east. If so, less contaminated groundwater is more likely to discharge to the river in the vicinity of prime salmon spawning areas (north of Gable Gap) than is currently the case. Predictions from numerical models have resulted in conflicting conclusions as to whether groundwater will move through Gable Gap in the future.

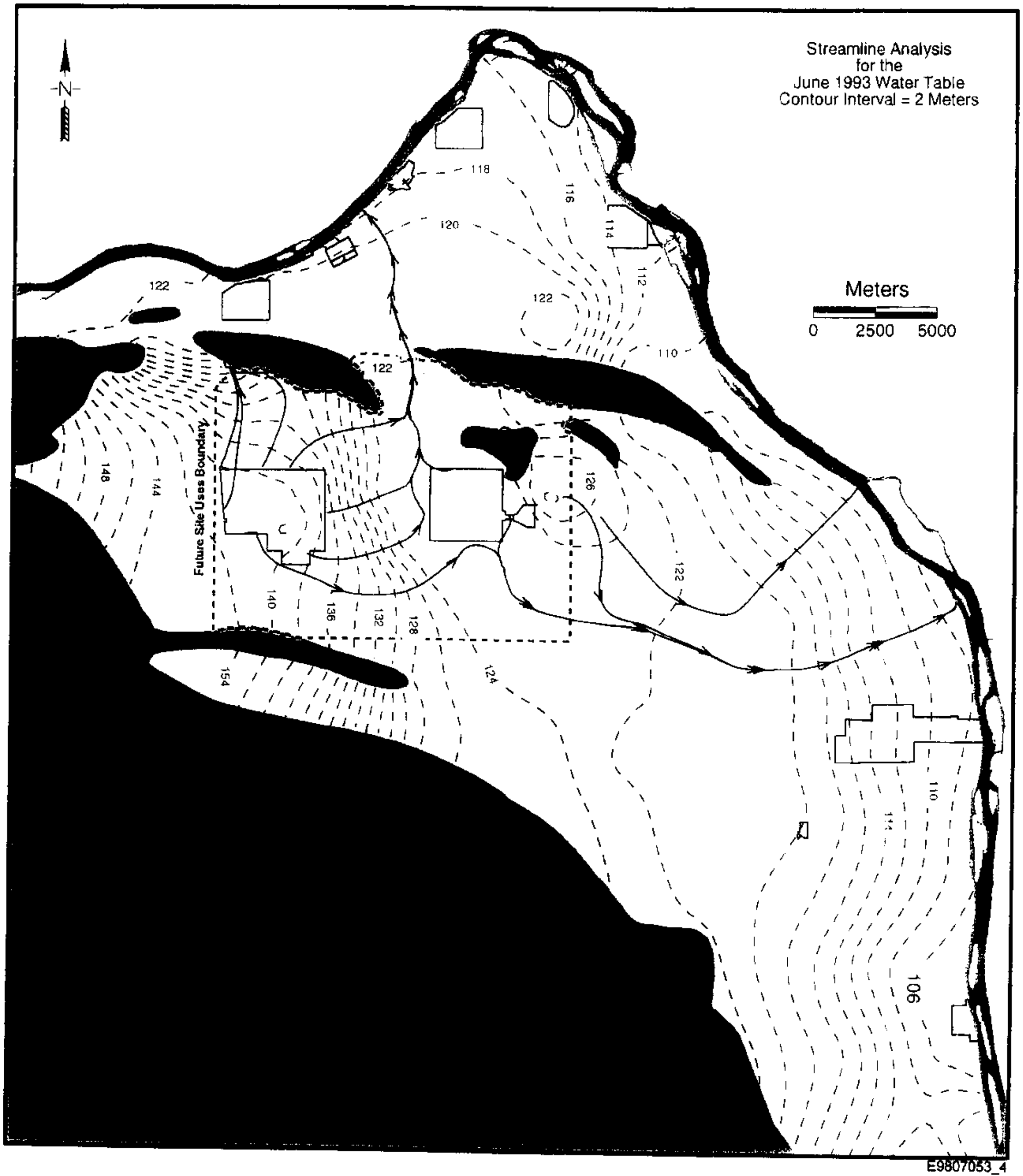
Estimated groundwater travel times to the Columbia River from the 200 West and 200 East Areas are about 100 years and 10 to 20 years, respectively. The longer travel time for the 200 West area is attributed to the less permeable aquifer host rock beneath the 200 West Area. Travel times are expected to be longer in the future, as the water table continues to decline.

Agricultural Impacts. The Columbia River Basin irrigation project has produced a massive groundwater mound on the east side of the Hanford Reach. This mound is thought to account for the upward flow potential of groundwater in the uppermost confined aquifer beneath the 100 Areas. In addition, withdrawals from the confined aquifer system in the upper Cold Creek valley have caused a permanent head loss of ~ 200 ft in this area. The impact on groundwater flow beneath the Hanford Site is unknown.

Water Quality. Groundwater in the unconfined and upper confined aquifers beneath the Hanford Site is a calcium-magnesium bicarbonate type water. It is slightly alkaline (pH ~8), has a relatively low dissolved solids content (~200 - 300 mg/L), and moderate alkalinity or hardness (100 - 150 mg/L as $CaCO_3$). The influence of Hanford Site activities on groundwater quality is discussed in Section D.1.3.4.

Water Quantity. The unconfined aquifer underlying much of the Hanford Site is capable of supplying water in sufficient quantity for most domestic uses, and is thus classified as a Class I aquifer. This acquifer is subject to groundwater protection and related cleanup regulations.

Figure D-4. Groundwater Streamlines for the Central Plateau.



Columbia River. The Columbia River is a large, fluvial body of oligotrophic, slightly alkaline water. Compared to other rivers, it has a very low content of suspended particulate matter (e.g., < 10 mg/L above its confluence with the Snake River, reaching an average of 40 mg/L at the mouth). The low suspended sediment content is attributed to the predominance of crystalline rock in the upper drainage basin. The alkaline pH enhances sorption of dissolved heavy metals (from mining and refinery operations).

Flow characteristics vary in response to the amount of snow pack and melting conditions in the drainage basin. The average flow is about 100,000 cfs in the upper river, increasing to ~250,000 at the mouth. There are 11 dams in the Columbia River drainage basin within the U.S., and three in Canada (see Figure D-1). Except for Grand Coulee, the dams operate in the "run of the river" mode for power production. Lake Roosevelt serves as the primary flood control dam.

Lake Roosevelt, behind Grand Coulee Dam, and Lake Wallula, formed by McNary Dam, are the principal sediment traps in the river-reservoir system below the Canadian border. Very little fine sediment accumulates in most of the other reservoirs due to the relatively fast-flowing conditions, long narrow reservoirs, and the low suspended sediment load of the river. Where fine sediment does accumulate, average deposition rates are only a few cm/yr. Thus, sediment-bound contaminants in these depositional sites are not rapidly attenuated ("buried"), and are more subject to resuspension during unusually high runoff or during rapid drawdown of the reservoirs.

Hanford Reach. The Hanford Reach, below Priest Rapids Dam, is the only free flowing section of the river upstream of Bonneville Dam. Diurnal and seasonal water level extremes of up to 10 feet occur due to the use of Priest Rapids Dam for peak power generation and the annual variability resulting from snow melt runoff or freshets. The river stage fluctuations in the Hanford Reach play a significant role in groundwater-contaminant interactions at stream bank discharge sites, and beneath effluent disposal sites near the river.

The extent of mixing, dilution, and upwelling of groundwater in streambed gravels involves relatively unknown factors, but these are important considerations in assessing current and future impacts in this critical natural spawning habitat for chinook salmon.

D.1.3 Contaminant Sources

Residual contaminants in facilities and in the vadose zone from past-practice operations and unplanned releases at the Hanford Site are potential sources of soil and groundwater contamination. The relative importance of these sources depends on their magnitude, relative hazard, the presence of a hydraulic gradient and aquifer recharge, contaminant mobility, and contaminant concentration at the point of exposure. This section summarizes the status of current contamination in facilities, soil, groundwater, and the Columbia River.

D.1.3.1 Surplus and Active Facilities

Surplus. Contaminated reactors, equipment, and associated processing facilities are human exposure hazards, as well as potential sources of soil and groundwater contamination. Accordingly, decommissioning of surplus facilities at the Hanford Site has continued for ~23 years. The last of the older production reactors at the Hanford Site was shut down in 1971, followed by the N Reactor in 1987. In 1973 a program was instituted for the disposal/decommissioning of all "surplus facilities" at the Hanford Site. Since the program's inception, approximately 275 facilities have been demolished and/or decontaminated. In addition, the program was responsible for implementing the underground storage tank regulations. This resulted in the removal of approximately 57 gasoline and diesel storage tanks over a four-year period.

Currently, there are 117 facilities to be decommissioned. These include the nuclear reactors, and all their remaining ancillary facilities, canyon (processing facilities) buildings, and miscellaneous smaller structures. During the next ten years, an additional 200 facilities will probably be transitioned into the program. The current deadline for completing decommissioning of facilities currently in the program 2018 (with the exception of the reactors).

Active. In addition to surplus facilities, there are a large number of in-use or active facilities. Radioactive and hazardous material storage and processing facilities will be potential exposure sources until they are eventually decommissioned at the end of the cleanup period. These facilities include (1) the canyons and tunnels in the PUREX plant area; (2) waste handling and repackaging facilities in the 200 West Area; (3) future vitrification plant and associated waste handling facilities; (4) the Plutonium Finishing Plant and fissile material storage areas; (5) the Effluent Treatment Facility and associated equipment; (6) U, T, and B Plants; (7) the dry canister storage building (for encapsulated K basins fuel); (8) the 241-A evaporator; (9) tank-farm-related waste handling and transfer lines; and (10) laboratories and test facilities. The currently active facilities become post-cleanup surplus facilities as the various phases of environmental restoration are completed.

D.1.3.2 Vadose Zone Effluent Disposal and Storage Sites

Vadose zone effluent disposal sites are most conveniently grouped and discussed in terms of the area of the Hanford Site in which they operated. Most of the waste stored in, or discharged to, the ground by Hanford Site operations is in the 200 Areas. The 100 Area sites have been given first priority for remedial action because of their proximity to the river.

D.1.3.2.1 100 Area. Vadose zone sources near the river include cribs, trenches, other disposal sites, contaminated buildings and associated reactor cores, and spent nuclear fuel storage basins associated with past reactor operations. Contaminated soil sites are being excavated, and the excavated materials are trucked to the Environmental Restoration Disposal Facility (ERDF). Buildings are being decontaminated and either demolished and/or stabilized in-place. As of July 1998, more than 1,000,000 tons of contaminated soil and debris have excavated from the 100 Areas.

Reactor cores (graphite blocks with residual carbon-14 and chlorine-36 and other activation and fission products) will be left in place for up to 75 years to allow residual decay to occur. At that time, the cores will be removed (or final disposition will be re-evaluated). Evaluation of long-term seismic hazards is an important consideration for final disposition of the reactor cores.

Some past-practice effluent disposal sites are current sources of groundwater contamination. For example, carbon-14 and tritium continue to emanate from french drains used to dispose of reactor gas-loop condensate in the 100 K Area. High levels of strontium-90 also leach from the soil column to the groundwater near reactor buildings. Strontium-90, other fission products, and transuranic radionuclides have been added to the soil column through past leakage of contaminated basin water from the 100 KE nuclear fuel storage basin. The spent fuel stored in the 100 KW and KE basins is the second-largest source of waste on the Hanford Site. It accounts for ~ 80% of the nations' defense-related spent nuclear fuel in storage. Work is underway to encapsulate and remove the fuel to dry storage in the 200 Area by 2004.

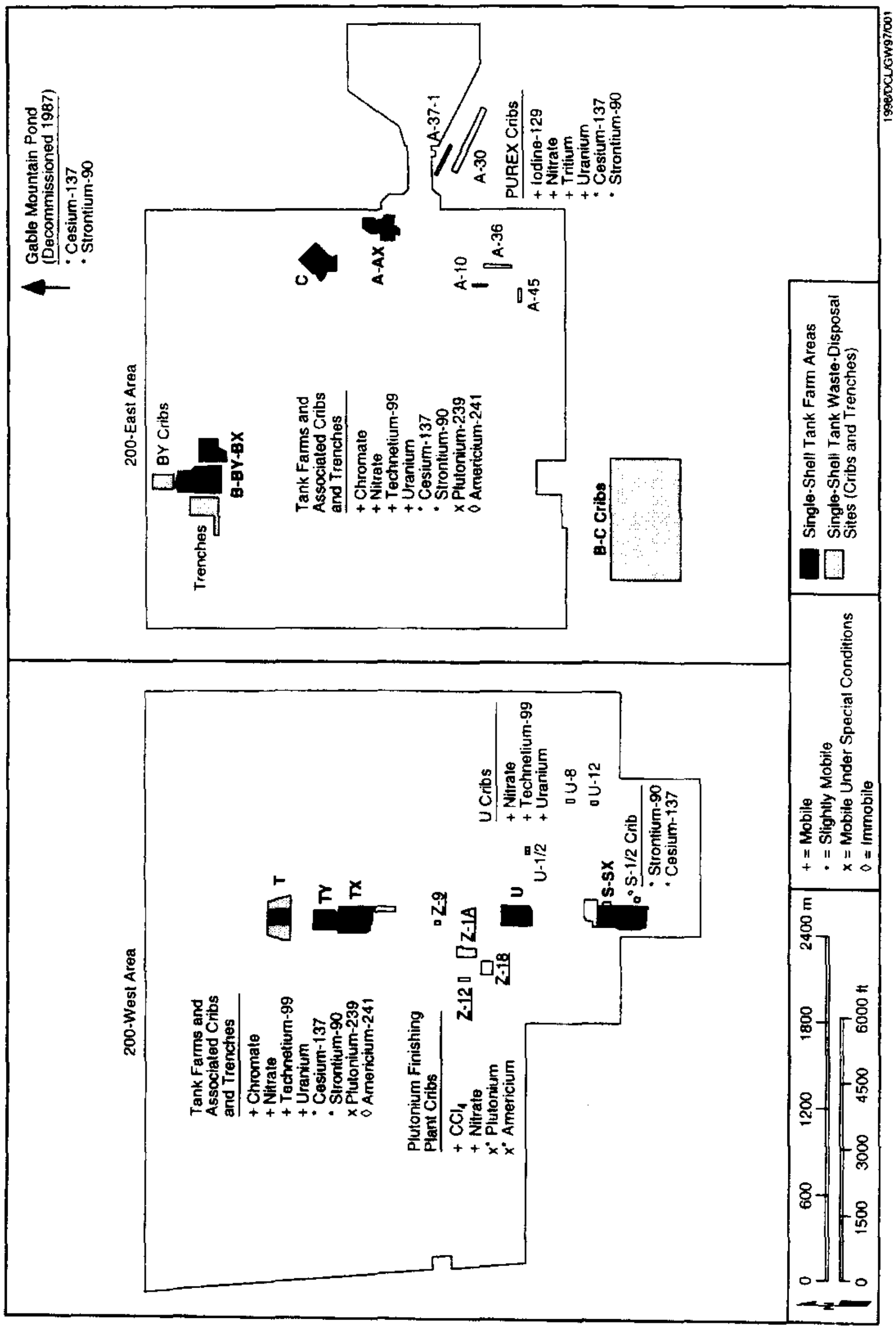
Groundwater contamination near the KE reactor building is thought to result from enhanced infiltration of surface water runoff from buildings and paving that leaches contaminants from effluent disposal sites. Leaking water lines and fire hydrants adjacent to these contaminant sources are also possible contributors. The more mobile components of this waste , especially tritium, have reached the river. Concentrations of tritium in streambank gravels, however, are currently at or below drinking water standards. The feasibility of interim or near-term corrective measures to remove or attenuate the vadose zone sources of tritium, carbon-14, and strontium-90 is under review.

D.1.3.2.2 200 Areas. Locations and types of vadose zone contamination in the 200 Areas are summarized in Figure D-5. Specific waste sites were grouped and ranked based on the potential for contaminants to reach groundwater, mobility factors, and/or the nature and magnitude of the source. The highest-ranked sites were as follows:

- *Plutonium/organic-rich process waste group* (Z Plant cribs that received mixtures of complexant, > 500 metric tons of carbon tetrachloride, and an estimated 20,000 Ci of transuranics in both particulate and semi-mobile chemical states). The Plutonium Finishing Plant (PFP) cribs are the second-largest or most significant source of soil and groundwater contamination on the Hanford Site. Plutonium-239 and americium-241 occur at much greater depths in the soil column beneath the organic-rich process-waste disposal sites than at other liquid waste disposal or spill sites. Soil vapor extraction has been conducted to remove as much of the carbon tetrachloride as practical.

- *Scavenged waste group* (single-shell tank waste discharged to cribs after in-tank precipitation to reduce cesium-137 and strontium-90. Primary mobile contaminants of interest are technetium-99, chromate, and nitrate). The large volumes of effluent discharged to the soil column resulted in breakthrough of contaminants to the groundwater, leaving significant residual waste in the vadose zone that is subject to long-term leaching to the water table.

Figure D-5. Major Vadose Zone Contamination Sites.



- *Chemical sewer group* (chemical and fission product waste releases from B Plant and PUREX operations into ditches and pond).

Not ranked, but potentially significant, were unplanned releases from tank-farm-related transfer lines, diversion boxes, tanks, and pits. The occurrences of technetium-99 and associated tank-waste contaminants (hexavalent chromium and nitrate) in downgradient groundwater monitoring wells at four of the seven tank farm waste management areas emphasizes the potential impact of these sources. While the current magnitude of the recent tank-farm-related groundwater contamination is eclipsed by other groundwater contamination, it may indicate preferential pathways through the vadose zone to groundwater.

Other important vadose zone sources of future groundwater contamination in the 200 Area include the ERDF, near the 200 West Area, the [future] low-level vitrified waste disposal site (ILAW), near the PUREX plant, and the low-level waste (submarine reactor compartment) burial ground in the 200 East Area.

Injection wells are another miscellaneous source of vadose/groundwater contamination. Two classes of these wells were used at the Hanford Site: (1) class IV (which received hazardous and radioactive waste); and (2) class V (for disposal of miscellaneous waste streams; steam condensate, storm water, etc.). A list of the Class V injection wells was compiled and documented in *Registration of Hanford Class V Underground Injection Wells* (DOE/RL 88-11). Most of the class IV wells (or "reverse" wells) were completed at varying depths above the water table. A few were completed directly in the uppermost unconfined aquifer. Examples of the latter occur in both the 100 Areas (reactor and storage basin effluent disposal) and in the 200 Areas (process-related effluent disposal). Knowledge of chemical conditions, depth distributions, and lateral extent of the vadose zone contaminants at most of the above sites is deficient. Characterization work (e.g., core sampling and analysis) is needed to assess the full nature and extent of vadose zone contamination beneath major facilities, and to support remediation and closure decisions.

D.1.3.2.3 300, 600, and 1100 Areas

The major vadose zone contaminant sources in the 300, 600, and 1100 Area include the (1) commercial low-level waste disposal site operated by U.S. Ecology south of the 200 East Area; (2) the sanitary waste landfill and the non-radioactive dangerous waste landfill southwest of the 200 East Area; (3) past-practice burial and wastewater disposal trenches in the 300 Area; (4) the wastewater disposal pond in the 400 Area; (5) the 1100 Area landfill; and (6) process waste ponds associated with the Siemens commercial nuclear fuel fabrication facility. The commercial sites are licensed by the Nuclear Regulatory Commission (NRC).

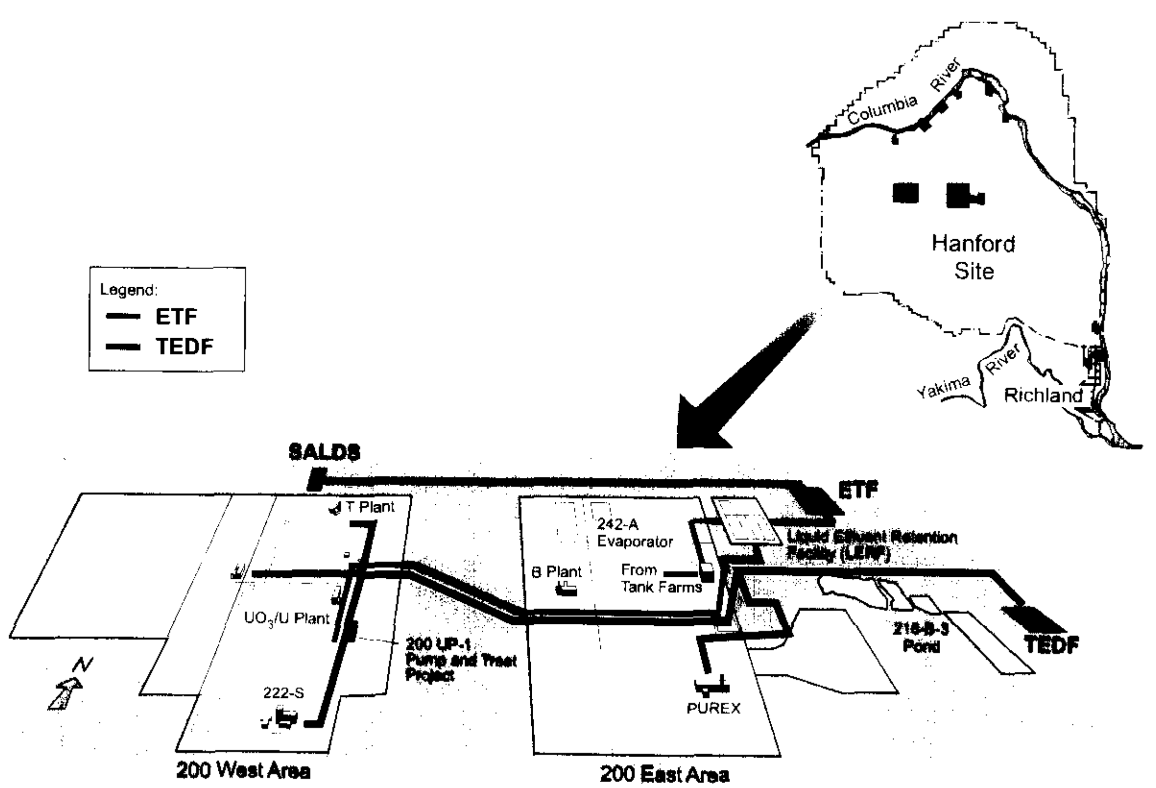
Separate monitoring and reporting requirements apply to the NRC regulated facilities. However, monitoring data from these commercial operations complement the Hanford Site groundwater monitoring program (and vice versa).

Termination of liquid discharges and ongoing soil remediation efforts have eliminated most of the groundwater contamination sources that are associated with the 300 Area process trenches. The 1100 Area landfill and other 1100 Area contaminant sources have been closed. Efforts are under way to remove the uranium-contaminated solvents buried in drums at the 618 burial ground in the 300 Area. Thus, relative to the 100 and 200 Areas, these sources are secondary contaminant sources.

D.1.3.3 Active Effluent Discharges

Discharge of untreated wastewater to the ground ended in 1995. This action eliminated a driving force for continued movement of moderately mobile contaminants in the soil column beneath major, effluent disposal structures. The wastewater is now collected from 200 Area facilities and discharged to two wastewater disposal facilities operating under WAC 173-216 discharge permits, depending on the nature of the initial waste stream. The waste streams with hazardous and radioactive constituents are treated and all constituents but tritium are removed prior to discharge to the State Approved Land Disposal Site (SALDS) facility north of the 200 West Area (Figure D-6). Pavement runoff, cooling water, and related non-contact waste streams are monitored and discharged to the Treated Effluent Disposal Facility (TEDF) east of the 200 East Area.

Figure D-6. 200 Area Effluent Treatment Facility, Collection, and Disposal Network.



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There are about 80 septic systems for disposal of sanitary wastewater at the Hanford Site. Volumes are not recorded for most of these miscellaneous discharges. Evaluation and eventual elimination of these discharges (to the extent feasible) was part of the miscellaneous waste streams review.

D.1.3.4 Groundwater Contamination

As noted above, the major sources of current groundwater contamination (untreated process-waste streams) have been eliminated. Thus, the current groundwater contaminant plumes (Figure D-7 and D-8) are primarily due to past-practice effluent discharges.

D.1.3.4.1 Contaminant Plumes. A groundwater remediation strategy was developed to address the most significant groundwater contaminant plumes. Implementation of that strategy was initiated in 1994, and includes on-going pump-and-treat projects in the 200 West Area (carbon tetrachloride, uranium/technetium-99), and the 100 Areas (chromium at 100-D, 100-H, and 100 K, and strontium-90 at 100-N).

Other wastewater discharges include National Pollutant Discharge Elimination System (NPDES) and 216 facility discharges. The NPDES permit sites include treated or non-contaminated wastewater discharges to the Columbia River in the 100 K Area, the 300 Area and treated effluent disposal facility, and effluent disposal in the 400 Area.

D.1.3.4.2 Depth in the Aquifer. The vertical distribution of contaminants in the uppermost unconfined aquifer has been assumed to be limited to the top 10 m or less. However, there is evidence for more deeply dispersed contaminants at some locations. For example, carbon tetrachloride occurs at the bottom of the uppermost aquifer in one well near the 216-Z-9 trench (Figure D-5). Tritium has been measured in the uppermost confined aquifer near the B pond (4,000 pCi/L). Other instances of deeply distributed tritium include the sanitary landfill downgradient from the 200 East Area. There are also indications that high-salt waste from the cribs that received single-shell tank overflows may have migrated more deeply into the aquifer than previously assumed. The significance of the more deeply distributed contaminants is not clear. Migration rates may be slower in the deeper aquifer. At the aquifer discharge boundaries at the Columbia River, shallow contaminant plumes may tend to discharge along the shoreline, while the more deeply distributed contaminants would tend to enter the river at a greater distance from the shore. Thus, the latter could have a relatively more impact on salmon spawning beds, but may also be more readily mixed (diluted) in the river water.

D.1.3.5 Contaminant Distribution in the River

Two segments of the Columbia River are described in this section: the Hanford Reach, and the lower Columbia River.

Figure D-7. Areal Distribution of Radioactive Contaminants.

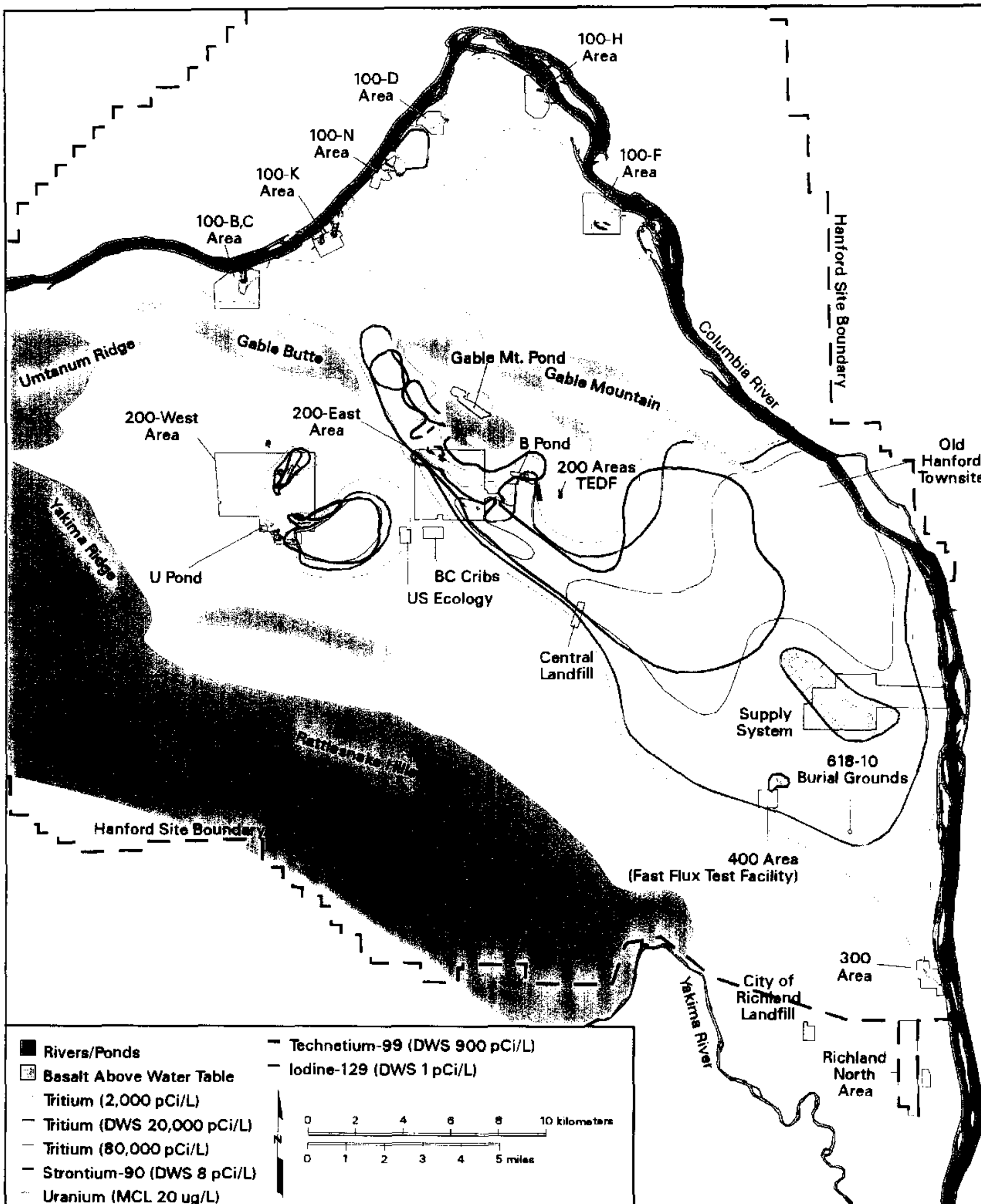

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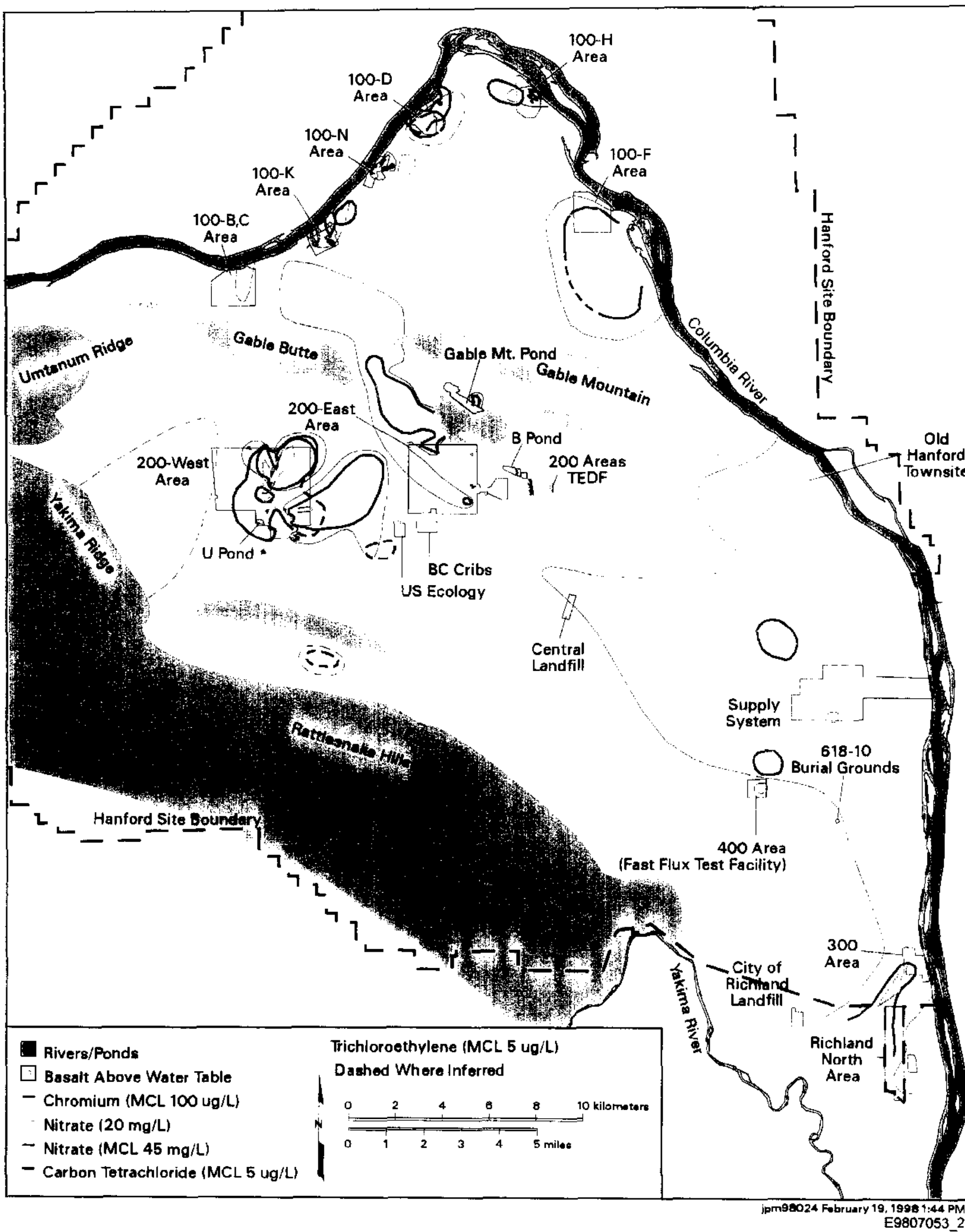
Figure D-8. Areal Distribution of Chemical Contaminants.



D.1.3.5.1 Hanford Reach. Hexavalent chromium (up to 600 µg/L in streambed pore fluid near 100-D) and strontium-90 in the stream bank sediments near the 100 N area (up to 200 pCi/g) indicate current contamination in groundwater discharging to the Columbia River in the Hanford Reach. The goal of reducing the discharge of hexavalent chromium at the shoreline, near the salmon spawning habitat, is the primary reason for the ongoing pump and treat and related remedial actions in this area.

Besides these contaminant discharges to the Columbia River, environmental surveys fail to indicate large inventories of other Hanford Site contaminants. Heavy metals (copper, lead, cadmium, and zinc) are above natural levels in fine sediment fractions collected from the Hanford Reach, but can be attributed to upstream mining and related sources.

D.1.3.5.2 Lower River. Hanford Site radionuclides in fine-textured sediments behind McNary Dam and in the Columbia River estuary resulted from past-practice discharges and include long-lived fission and activation products, and trace amounts of transuranics. However, contemporary concentrations of long-lived radionuclides (e.g., cesium-137) are similar to (or lower) than nuclear weapons fallout levels in sediments of the Bull Run watershed (a reservoir near Mt. Hood that provides drinking water to Portland, Oregon). This finding is consistent with the results of an environmental survey conducted from 1992-94 of the lower Columbia River, below Bonneville Dam. That study indicated non-detectable levels of Hanford Site radionuclides in Columbia River sediments. Only elevated concentrations of heavy metals and other non-Hanford Site related contaminants were found.

Perhaps the greatest significance of Hanford Site radionuclides in the Columbia River system is as tracers. This large and dynamic ecosystem was uniquely labeled in the past with radionuclides from the Hanford Site to the coast. Previous studies provided information about sediments and biodynamics that, in turn, can be used to assess the behavior and likely distribution and concentration of future contaminants, especially those with an affinity for particulates. The residual radioactive tags from the Hanford Site that are still detectable in the sediments of depositional sites can also be used to document historical inputs from other upper drainage basin sources.

D.2 ON-GOING PROJECTS RELEVANT TO THE INTEGRATION PROJECT

Project activities relevant to the mission of the Integration Project are performed by several organizations at the Hanford Site. The work is managed by the PHMC, the ERC, and PNNL. Pertinent information generated by past and present work must be factored into an integrated body of knowledge in order to effectively protect and remediate Hanford Site groundwater resources and the Columbia River.

This section describes the current scope of the various projects at the Hanford Site that play a role in protection and remediation of Hanford Site vadose zone, groundwater, and the Columbia River. The information that is summarized includes (1) generation and use of project information relative to the nine technical elements identified in the *Project Specification*; and

(2) programmatic information for work conducted within the current budget/cost/schedule baseline. This information will be used to identify (1) related and overlapping scopes of work among the various projects; (2) gaps in information needed to support the technical elements of the Integration Project; and (3) opportunities to more efficiently and effectively manage related work within and among the various projects.

D.3 RELATIONSHIP OF PROJECT INFORMATION TO TECHNICAL ELEMENTS

Information generated or used by the various projects, and the relationship of that information to the nine technical elements (specified by the Integration Project), are identified in Table D-1. The project relationships to the technical elements are defined in terms of whether the project is a direct generator and/or user of information.

The scope of the long-term remediation options element includes work focused on short-term mitigation.

Table D-1. Matrix Showing Relationship of Projects to Technical Elements.

Projects/Activities	Inventory	Vadose Zone	Groundwater	Risk Assessment	Monitoring	Remediation Options	Regulatory Path	Site-Wide Assessment Method	River Impact
TWRS/ILAW (FDH/LMHC)	U	G/U	G/U	G	N	N	G/U	G/U	G
TWRS Hanford Tanks Initiative (FDH/LMHC)	U/G	U/G	U	G/U	N	G	G	N	N
TWRS Vadose Zone Program (FDH/LMHC)	G	G	U	G	G/U	G	U	U	U
TWRS SST Vadose Zone Spectral Gamma Baseline Characterization (GJO/MacTec)	G/U	G/U	N	N	N	N	N	G	G
Solid Waste (FDH/WMH)	U/G	G/U	U	G	N	N	G	G/U	G

Table D-1. Matrix Showing Relationship of Projects to Technical Elements.

Projects/Activities	Inventory	Vadose Zone	Groundwater	Risk Assessment	Monitoring	Remediation Options	Regulatory Path	Site-Wide Assessment Method	River Impact
Liquid Waste Effluent Treatment and Disposal (FDH/WMFS)	G/U	G	G	N	G	G/U	G	G/U	G
K-Basins (FDH/Duke/Numatec)	G	N	G	N	G	G	G	N	G
Infrastructure (FDH/Dyncorp)	N	G	G	N	N	G	N	N	G
Environmental Restoration 100 Areas (BHI)	G/U	G/U	G/U	G/U	G/U	G/U	G/U	G/U	G/U
Environmental Restoration 200 Areas (BHI)	G/U	G/U	G/U	G/U	G/U	G/U	G/U	G/U	G/U
Environmental Restoration 300 Areas (BHI)	G/U	G/U	G/U	G/U	G/U	G/U	G/U	G/U	G/U
Environmental Restoration Disposal Facility (BHI)	G/U	G/U	G/U	G/U	G/U	G/U	G/U	G	N
Surveillance & Maintenance (BHI)	G/U	G/U	G	G	G	G/U	N	G	N
Decontamination & Decommissioning (BHI)	G/U	G/U	U	G/U	G/U	G/G	G/U	G	N
Groundwater Management (BHI)	G/U	G/U	G/U	G/U	G/U	G/U	G/U	U/G	G/U
N-Reactor Deactivation (BHI)	G/U	G/U	N	N	N	G/U	G	G	N

Table D-1. Matrix Showing Relationship of Projects to Technical Elements.

Projects/Activities	Inventory	Vadose Zone	Groundwater	Risk Assessment	Monitoring	Remediation Options	Regulatory Path	Site-Wide Assessment Method	River Impact
Site Surveillance (PNNL)	U	U	G	G	G	N	G	G	G
Consolidated Site - Wide Model (PNNL)	U	U	U	G	U	U	G	G	G

G = Generator of Information
U = User of Information
N = Non-Generator/Non-User of Information

D.4 PROGRAMMATIC INFORMATION

This section summarizes programmatic information for the ongoing projects listed in Table D-1, and includes (1) a general description of the project scope; (2) objectives and responsibilities; (3) regulatory drivers of the activity; and (4) activities relevant to the Integration Project.

D.4.1 Programs Managed by the PHMC

The subsections that follow summarize programmatic information provided by PHMC team - managed projects. Fluor Daniel Hanford, Inc. is the integrating contractor for the PHMC, and provides overall project direction to its "major" subcontractors. The major subcontractors are responsible for execution and performance of their designated projects.

D.4.1.1 TWRS Immobilized Low Activity Waste (ILAW)

ILAW refers to a set of project activities performed as part of the TWRS Immobilized Tank Waste Storage and Disposal Project. The TWRS Immobilized Tank Waste Storage and Disposal Project is responsible for the following:

- On-site transportation and storage of the vitrified waste produced by private vendors under contract to RL.
- On-site disposal of immobilized low activity tank waste (ILAW) - vitrified low-activity tank waste.

- Eventual shipment of the vitrified high-activity tank waste to a federally licensed geologic repository.

ILAW project activities are the responsibility of the Lockheed Martin Hanford Company (LHMC), which is a major subcontractor under the direction of FDH. Geotechnical information is generated by the program for use in permit applications and other regulatory documents, particularly the long-term radiological performance assessment required by DOE Order 5820.2A.

Tri-Party Agreement milestone drivers are as follows:

- M-90-05T - Submit Final Performance Assessment, December 2001.
- M-20-57 - Submit ILAW Storage RCRA Part B, December 2000.
- M-20-58 - Submit ILAW Disposal RCRA Part B, December 2003.

The ILAW disposal facility will be constructed on unused land south of the PUREX facility in the 200 East Area. The performance assessment analyzes the potential long-term impacts (thousands of years) from disposal of ILAW. Authorization to construct the disposal facilities relies on the outcome of the performance assessment. The performance assessment is the basis for setting requirements for the design and use of disposal facilities, for waste form specifications, and the performance assessment supports TWRS privatization decisions. Activities to be performed for updating and revising the performance assessment include the following:

- Vadose zone computer code selection and development.

- Groundwater computer code/model selection.

- Far-field hydraulics relative to stratigraphy, clastic dikes, and soil physical properties.

- Near and far-field geochemistry relative to contaminant transport.

- Recharge lysimetry and evapotranspiration measurements and simulations relative to engineered barriers and cover material.

- Borehole characterization.

- Geologic information collection - stratigraphy, seismic, clastic dikes, waste form natural analogues and natural background levels.

Modeling conducted for the performance assessment includes analyses of recharge, waste form performance, vadose zone flow and transport, groundwater flow and transport, and receptor exposure.

D.4.1.2 TWRS Hanford Tanks Initiative

The Tank Waste Remediation System (TWRS) mission includes retrieval and vitrification of hazardous and radioactive waste from the tank farms, and closure of the partially emptied tanks. The retrieval of wastes from the tanks encompasses many uncertainties and technical challenges that affect major planning and execution decisions for several complex, lengthy, and costly TWRS projects. The capability to retrieve some types of hard-packed waste by conventional hydraulic sluicing is uncertain, as are the effects of sluicing on tank integrity and consequent leakage of tank wastes to vadose zone sediments. Also unknown is whether tank farms may be closed in compliance with applicable environmental regulations, with residual wastes remaining in the tank and underlying soils.

There is significant risk implementing the TWRS program unless waste retrieval performance requirements are defined and widely accepted, and the capability of retrieval systems are demonstrated as being appropriate and adequate. In an effort to help minimize programmatic risk and uncertainties, DOE's Office of Waste Management (EM-30) and Office of Technology Development (EM-50) combined technical and financial resources to establish the Hanford Tanks Initiative (HTI) Project. The purpose of the HTI is to demonstrate proposed tank waste retrieval methods, and to provide a basis for design and regulatory decisions affecting the remainder of the TWRS tank waste retrieval program.

The HTI Project has selected two high-level radioactive waste tanks (241-C-106 and 241-AX-104) for demonstration purposes. The respective objectives of the two demonstrations are to gain key technical, cost performance, and regulatory information. Waste retrieval will be demonstrated in tank 241-C-106; a tank closure assessment will be demonstrated for tank 241-AX-104. Tank 241-AX-104 previously was sluiced as part of a strontium recovery operation in the early 1970s.

Objectives specified by the HTI Project are as follows:

- *Remove Residual Waste* - Apply technologies and processes to remove the hard-heel and other waste expected to remain in tank 241-C-106 following waste retrieval by sluicing, and determine the technical feasibility and cost effectiveness of these technologies and processes.

- *Establish Retrieval Performance Criteria* - Establish quantitative measures of retrieval performance for alternative retrieval and closure technologies, and criteria for tank farm closure, by using results from performance analyses and risk and compliance assessments.

- *Model Contaminant Transport* – Apply a method and process to predict the transport of residual radioactive and hazardous materials to the environment from the tank, surrounding contaminated soil, and ancillary equipment.

- *Determine Residual Waste Volume* – Select instrumentation and determine capabilities to measure the residual waste volumes remaining in tanks 241-AX-104 and 241-C-106 after sluicing operations.

- *Sample Residual Tank Waste* – Select instruments to sample relatively small quantities of waste remaining in tank 241-AX-104.

- *Sample and Characterize Soil* – Select instruments to measure contamination, if any, in the backfill around tank 241-AX-104, and obtain other hydrologic characterization information required for tank closure.

LMHC is the responsible subcontractor. Funding for the HTI is provided by DOE's Office of Waste Management (EM-30), and the Office of Science and Technology (EM-50). The primary regulatory drivers for the HTI Project are as follows:

- RCRA
- *Superfund Reauthorization Act*
- DOE Order 5820.2A
- DOE/EPA/State Agreements (*Tri-Party Agreement* Milestones M-45-00 and M-45-06).

Activities relevant to the Integration Project include information generated for the retrieval performance evaluation criteria, modeling of contaminant transport, tank waste inventory characterization and volume analyses, and development/ testing of a multi-probe cone penetrometer for vadose zone characterization beneath the tanks.

D.4.1.3 TWRS Vadose Zone Program

The TWRS Vadose Zone Program was developed in FY97 to support activities performed by a number of TWRS projects that require vadose zone and groundwater information, including the following:

- Waste Retrieval – initial single shell tank retrieval system (ISSTRS), supplemental single shell tank retrieval system (SSSTRS), Phase 2 privatization retrieval.

- Tank Farm Closure – single shell tank (SST) farm closure.

- Double-shell tank (DST) farm closure.

- Inactive miscellaneous underground storage tank (IMUST) closure.

- Safe storage in SSTs.

The objective of the TWRS Vadose Zone Program is to develop a sufficient understanding of subsurface contamination and transport to support decisions in the following areas:

- Management of past SST leaks.

- Controlling potential tank waste retrieval leaks.

- SST tank farm closure, including allowable residual waste following closure.

- Programmatic decisions to move forward with waste retrieval.

In addition, the program will assure that data gathering activities are focused on key decisions, and that these decisions are consistent with site-wide efforts to protect health and the environment.

LMHC is the responsible subcontractor for the following:

D.4.1.4 TWRS SST Vadose Zone Spectral Gamma Baseline Characterization Program

The TWRS SST Spectral Gamma Baseline Characterization Program (BCP) involves the application of passive spectral gamma-ray borehole geophysical logging methods to determine the current extent of vadose zone contamination associated with single-shell tanks. The BCP is the initial assessment of the distribution of gamma emitting radionuclide contamination in the vadose zone beneath the SST farms. The principal driver of the BCP is the need for tank-farm-specific information on subsurface contaminant migration and mobility. This information supports TWRS decisions on interim storage, waste retrieval, tank closure, engineering-related performance assessments, and risk assessments. The scope of this program includes the following activities:

- Log all of the existing boreholes surrounding each tank.

- Determine the concentrations of gamma-emitting radionuclides in the sediments penetrated by the boreholes.

- Complete the first comprehensive database of gamma emitting radionuclide contamination.

- Create three-dimensional representations of the subsurface, gamma emitting radionuclide contamination.

At present, the BCP is not tied to the *Hanford Integrated Site Baseline* or other schedules. Milestones for vadose zone characterization are not specified in the *Tri-Party Agreement*. The BCP vadose zone characterization information will support activities related to *Tri-Party Agreement* milestones for retrieval of SST waste and eventual closure of the SSTs, and compliance with tank monitoring requirements specified by RCRA. The program is managed by the DOE-Grand Junction Office (GJO). The GJO project manager reports to the RL TWRS vadose zone project manager. Mactec-ERS is the GJO contractor performing the work at the Hanford Site.

Within the scope of this program, approximately 800 boreholes are being logged. The boreholes are leak-detection drywells that surround 149 single-shell tanks. The results are being reported in 134 separate reports, one for each tank with accessible boreholes. Summary reports will be prepared for each of the 12 single-shell tank farms. This work is being conducted over a five-year period. Interpretations of data collected by the BCP indicate that, at some locations beneath the BX and SX Tank Farms, radioactive contaminants are distributed at greater depths than expected. Completion of the current scope is expected by August 1999.

D.4.1.5 Solid Waste Project

Waste management activities are conducted at the following location:

- Low-Level Burial Grounds (LLBG), for disposal of low-level radioactive solid waste.
- Central Waste Complex (CWC), for storing transuranic (TRU) and mixed waste.
- T Plant, for decontaminating equipment; the Waste Retrieval and Processing facility (WRAP), for treating TRU waste.
- Liquid Effluent Treatment facilities (200 ETF and 300 ETF) (see discussion of Liquid Waste Processing Facilities section D.4.1.6).

Of these facilities, only the LLBG in the 200 West Area and 200 East Area are projected to leave significant quantities of radioactive and potentially mixed waste permanently in near-surface soils. Waste Management Federal Services (WMFS) is responsible for operating the LLBG.

Low-level waste is received from onsite and offsite facility generators for disposal. The LLBG dispose of defense-generated, low-level, and mixed waste. Consequently, DOE orders (primarily DOE Order 5820.2a) and RCRA are the primary regulations. The LLBG currently comply with DOE Order 5820.2a, and an interim status operating permit has been approved by Ecology.

Assessments of risk for the LLBG are documented through completion of performance assessments, as required by DOE Order 5820.2a, *Radioactive Waste Management*. The scopes of these PA analyses include evaluation of radionuclide release scenarios for times after closure of the LLBG. Two PA analyses have been completed; one for the 200 West Area LLBG, and one for the 200 East Area LLBG. Conditional regulatory approval was granted. Final approval documented by a *Disposal Authorization Statement* is anticipated. At the completion of operations, the LLBG will require approval for closure from the DOE and Ecology in compliance with DOE Order 5820.2a and RCRA. Remediation options are not envisioned for the LLBG because the approved current operation practices are expected to preclude the need for future remediation.

Activities relevant to assessment of potential environmental contamination include the following:

- Routine surface monitoring for radioactive constituents.
- Recording of radioactive and chemical inventory disposal in the LLBG.
- Maintenance of performance assessment analyses that evaluate potential environmental contamination from disposed radioactive waste.

Additional characterization of vadose zone soils underlying the LLBG is not planned unless substantial changes in properties affecting radionuclide mobility are indicated from the vadose zone characterization efforts of other projects. Groundwater around the LLBG is monitored by the site-wide Surveillance Project in accordance with RCRA and DOE requirements. The surface and air are routinely monitored to ensure operational compliance. Other types of monitoring were considered by the project, but none have been adopted. Monitoring specific to the LLBG may be considered after covers have been placed over the closed LLBG.

The inventory of the LLBG changes constantly, as waste is routinely received. Inventory information is provided by the waste generator and is recorded in the Solid Waste Inventory Tracking System (SWITS). SWITS includes estimates of the inventories of all previous disposals, including waste disposed in the inactive burial grounds that are now closed. Inventory will continue to be recorded in SWITS as long as the LLBG are operable.

There is an annual review of the performance assessments. Adjusted dose due to additional inventory disposed in the burial grounds is estimated and evaluated. Other new information relevant to the performance assessment assumptions are reviewed and evaluated for incorporation to the document (e.g. ongoing simulations and measurements of buried concrete properties).

D.4.1.6 Liquid Waste Processing Facilities Program

Numerous processes and activities that generate contaminated waste water have occurred in the past at the Hanford Site. Current and planned processes and activities associated with cleanup of the Hanford Site will generate additional contaminated effluent. Prior to 1995, most effluent was discharged directly to the soil column via cribs, ponds, and ditches without prior treatment to remove radionuclides or hazardous chemicals. That past practice introduced significant contamination into the vadose zone and groundwater at many Hanford Site locations.

The Liquid Waste Processing Facilities Program (LWPFP), operated by WMH, provides integrated liquid effluent management services to support cleanup of the Hanford Site. The program mission is to manage current and future liquid effluent streams in a safe, responsible, cost effective, and legally compliant manner. Regulatory drivers of the program are the *Tri-Party Agreement* and the *Washington State Department of Ecology Consent Order DE 91NM-177*. All liquid effluent generated in the 200 and 300 Areas now flows into or through several treatment and/or storage facilities to remove contaminants before the effluent is discharged to the ground.

The effluents from the 200 Areas are RCRA-regulated waste streams, including those from the 242-A evaporator, liquids related to double-shell tank wastes, the UP-1 pump-and-treat project, 222-S laboratory wastes, and leachate from the ERDF.

New storage, treatment, and disposal facilities in the 200 Areas are being used to process these effluents. These facilities include the Liquid Effluent Retention Facility (LERF), the 200 Area Effluent Treatment Facility (ETF) and its associated 200 West Area disposal facility for treated water containing tritium, and the Treated Effluent Disposal Facility (TEDF) immediately east of the 200 East Area.

Wastewater from the 300 Area is treated by the 300 Area Treated Effluent Disposal Facility. Interim storage and transfer of effluents occurs within the 340 Waste Handling Facility. Databases used by the LWPFP include the HEIS and LEMIS (Liquid Effluent Monitoring Information System). Groundwater quality information is reported through quarterly data reports of monitoring results for the 200 East and 200 West area effluent disposal facilities, and through the annual tritium tracking report for the 200 West Area effluent disposal facility.

D.4.1.7 Spent Nuclear Fuels - K Basins

The mission of the K Basins project is to remove the spent nuclear fuel presently stored in the K Basins, and prepare it for placement in dry storage. Although there are no project activities dealing with the vadose zone or groundwater, fuel removal and cleanup of the basins will alleviate concerns regarding basin leakage to and contamination of the groundwater. The basins and surrounding contaminated soil and groundwater will eventually undergo D&D and remediation, following fuel removal and basin cleanout. Groundwater monitoring is performed by PNNL through the Hanford Site Groundwater Monitoring Program, described in Section D.4.3.1.

D.4.1.8 Infrastructure

Hanford DynCorp Tri-Cities Services, Inc. (DynCorp) is responsible for management and maintenance of Hanford Site roads, electrical power, potable- and process-water systems, sanitary waste water and storm water drainage systems, a solid waste landfill, and a non-radioactive dangerous-waste landfill. Water system leaks and discharges, landfill leachates, and sanitary waste or storm water discharges may facilitate transport of contaminants through the vadose zone to the unconfined aquifer.

Current methods of sanitary waste water treatment and disposal involve septic tanks and drain fields, and truck transport from holding tanks to the 100 N Area Sanitary Lagoon. The present sanitary waste water flow rate is about 400,000 liters/day; this volume is expected to decrease to about 150,000 liters/day by the year 2050. Regulatory controls on septic systems and drain fields are specified in WAC 246-272.

Within the 200 and 600 Areas, there are about 80 active septic systems. About half of these systems are not being operated under WAC 246-272 permits, and many are being loaded beyond their capacity or else are failing. Wastewater is pumped on a regular basis from the systems that are failing. The pumped water is transported by truck to a treatment facility (100 N Area Lagoon). Plans for future sanitary waste water management include the following:

- Treatment and disposal at upgraded, regionally located facilities, except where the existing facility serves a geographically isolated need that mandates use of a local septic system.
- Storage in holding tanks until periodic transport to a state-approved facility (probably the 100N-Area Lagoon) for treatment and disposal.

Current program activities are performed as site services, and are funded by pooled assessments.

D.4.2 Programs Managed by the ERC

The mission of the Richland ER Project is to manage and perform cleanup activities, other than those managed by the PHMC and its subcontractors, so as to preserve, protect, or restore the Hanford Site to allow other beneficial uses.

The Hanford Site contains more than 1,600 contaminated waste sites, with more than 500 of those within a half mile of the Columbia River. Additionally, there are more than 500 contaminated and/or surplus facilities at the Hanford Site. The ER Project is responsible for remediation of more than 1,200 of those sites, as well as for surveillance and maintenance, and decontamination and decommissioning of more than 200 facilities. Remediation of the remaining waste sites and facilities will either be transitioned to the ER Project in the future, or will be assigned to other Hanford Site projects. No remediation of single- or double-shell tanks is planned within the ER Project.

The primary regulatory driver for the ER Project is the *Tri-Party Agreement*. Enforceable under CERCLA and RCRA, the *Tri-Party Agreement* identifies specific commitments by RL to clean up the Hanford Site.

The ER Project is organized into five sub-projects, which are all significant for the purposes of the Integration Project. The five subprojects are as follows:

- Remedial Action and Waste Disposal
- Surveillance and Maintenance Project
- Decontamination and Decommissioning (D&D)
- Groundwater Management
- N Reactor Deactivation Project.

Environmental mitigation, remedation, and restoration activities focus primarily on sources of contamination in the 100, 200, and 300 Areas, with fewer activities directed toward source and groundwater contamination in the 600 Area.

D.4.2.1 Remedial Action and Waste Disposal Project

The Remedial Action and Waste Disposal Project is comprised of the following four subprojects directed to area sites (these are generally surface or rear surface contaminant waste sites).

- 100 Area Source Remedial Action Project.
- 200 Area Source Remedial Action Project.
- 300 Area Source Remedial Action Project.
- Environmental Restoration Disposal Facility (ERDF) Project.

Groundwater contamination is addressed by the ER Groundwater Management Project.

The general remedial process for the 100, 200, and 300 Areas source remedial actions include the following:

- Assessing the waste sites to determine the types and extent of contamination.

- Preparing the remedial design(s) and performing the remedial actions necessary to implement the RODs. Contaminated soil and solid waste removed from the 100, 200, and 300 Areas will be transported to the ERDF.

- Overseeing waste site closeout and revegetation.

D.4.2.1.1 100 Area Source Remedial Action Project. A major priority for the Hanford Site is to focus initial cleanup efforts on areas closest to the Columbia River. The 100 Areas Source Remedial Action Project (SRAP) addresses this priority. The 100 Areas are at the north end of the Hanford Site, along the Columbia River. The 100 Areas are comprised of six non-contiguous localities containing more than 400 waste sites, nine retired plutonium production reactors, and their ancillary facilities. "Remove-and-dispose" is the expected remediation technology for all of the 100 Area waste sites. The volume of soil and solid waste currently estimated as requiring removal from the 100 Areas exceeds 2.3 million cubic meters (~3 million cubic yards).

The planned remedial actions are designed to reduce risk to the public, workers, and the environment by removing and disposing of the contamination in the 100 Area at the ERDF. The objective of the project is to clean the 100 Area to a condition that will make the land suitable for other uses (in accordance with the RODs). Completion of the 100 Areas SRAP will be followed by long-term monitoring, to ensure continuing compliance with cleanup standards.

The SRAP coordinates the logistics of the project's assessment and remediation activities with ongoing waste management and D&D activities, and in conjunction with the Groundwater Management Project to ensure that source area cleanup goals are consistent with D&D and groundwater cleanup goals.

D.4.2.1.2 200 Area Source Remedial Action Project. The 200 Areas SRAP consists of approximately 700 waste sites located in and adjacent to the 200 East and 200 West Areas of the Hanford Site's Central Plateau. These waste sites resulted primarily from irradiated-fuel-processing activities that occurred in the 200 Areas. Soil and groundwater were contaminated when liquid waste was discharged to cribs and trenches or leaked from pipelines. In addition, solid wastes contaminated with radionuclides and hazardous chemicals were buried in unlined trenches. Soil contaminated by the liquid and solid wastes contains low-level radioactivity, low-level mixed wastes, and hazardous chemicals. The volume of soil and solid waste currently estimated as requiring removal from the 300 Area exceeds 750,000 cubic meters (1 million cubic yards).

The remedial actions are designed to reduce risk to the public, workers, and the environment by constructing engineered barriers to isolate contamination in the 200 Areas waste sites from the environment. Future use of much of the 200 Areas will be restricted to management of contaminated media and disposal of contaminated materials. Completion of the 200 Areas SRAP will be followed by long-term monitoring to ensure continuing compliance with cleanup standards.

The expected result is contaminant isolation through the capping of waste sites with barriers. Specifically, waste sites will be closed in place with surface barriers, or remedial alternatives will be established in accordance with specific RODs or permit modifications. Contaminated soils removed from 200 Area waste sites will be transported and disposed at the ERDF.

The SRAP coordinates the logistics of the project's assessment and remediation activities with ongoing waste management and D&D activities, and in conjunction with the Groundwater Management Project to ensure that source area cleanup goals are consistent with D&D and groundwater cleanup goals.

D.4.2.1.3 300 Area Source Remedial Action Project. The 300 Area is at the south end of the Hanford Site, adjacent to the northern boundary of the City of Richland, and bordering on the Columbia River. The 300 Area includes more than 100 waste sites. Liquid and solid wastes discharged and buried in the 300 Area contain both radionuclides and hazardous chemicals derived primarily from fuel fabrication and laboratory operations. These disposal practices resulted in contamination of the soil and uppermost aquifer.

A major priority for the Hanford Site is to focus initial cleanup efforts on areas closest to the Columbia River. The 300 Area SRAP addresses this priority to protect the Columbia River.

The planned remedial actions are designed to reduce the risk to the public, workers, and the environment by removing contamination in the 300 Area waste sites from the accessible environment. The objective of the remedial actions is to make the land available for industrial use. Completion of the 300 Area SRAP will be followed by long-term monitoring to ensure continuing compliance with cleanup standards.

The SRAP coordinates the logistics of its assessment and remediation activities with the Waste Management Projects and Landlord Projects.

D.4.2.1.4 Environmental Restoration Disposal Facility Project. The ERDF is located in the center of the Hanford Site, between the 200 East and 200 West Areas. The ERDF is a large-scale landfill and contains ancillary facilities designed to receive and isolate low-level radioactive waste, hazardous waste, or a combination thereof. The ERDF is a RCRA-compliant landfill authorized under CERCLA. The facility also complies with applicable or relevant and appropriate requirements that include WAC 173-303, Dangerous Waste Regulations, and EPA and DOE codes, orders, standards and regulations. The ERDF is designed to provide disposal capacity, as needed, to accommodate projected waste volumes for the next 20-30 years. When complete, the ERDF will be closed with a modified RCRA barrier. The ERDF will accept only waste generated by the ER Project. ERDF responsibilities include managing the following:

- Integrating the transportation and disposal of waste originated by the ER Project.
- Operation and monitoring of the ERDF.
- Integrating the design and construction of additional disposal capacity for the ERDF, as needed.
- Interim and final closure of the ERDF.

The initial two cells of the ERDF are 70-feet deep, 500-feet long, and 750-feet wide. The cells are lined with a RCRA Subtitle C-type liner and have a leachate collection system. The currently estimated total volume of contaminated materials to be buried at the ERDF exceeds 3 million cubic meters (4 million cubic yards). Completion of ERDF operations will be followed by long-term monitoring to ensure continued compliance with cleanup standards.

D.4.2.2 Surveillance & Maintenance Project

This project is subdivided into the Surveillance and Maintenance (S&M) Project and the Long-Term S&M Project.

D.4.2.2.1 Surveillance and Maintenance. The Hanford Site contains many inactive or decommissioned facilities that were required in the past for plutonium production. These facilities are now deteriorating. Because the facilities no longer serve a purpose, they must either be maintained (to preserve their integrity) or removed to (1) preclude the escape of potentially hazardous substances to the accessible environment; or (2) prevent unacceptable risks to the safety of the Hanford Site workforce. S&M is required for waste sites and facilities located throughout the Hanford Site until the facilities are decommissioned and waste sites have been satisfactorily remediated.

The S&M project is also responsible for Radiation Area Remedial Action (RARA), for approximately 1,000 inactive waste sites, including ten RCRA treatment, storage, and disposal (TSD) units. The TSDs include unplanned release sites, cribs, trenches, ponds, and burial grounds. The waste sites are located in the 100, 200, 300, and 600 Areas of the Hanford Site.

D.4.2.2.2 Long-Term Surveillance and Maintenance. Upon completion of remediation of contaminated waste sites and/or surplus facilities, the areas will be restored to permit future uses. Site restoration will consist mainly of topographic contouring and revegetation, with native species as appropriate. Upon completion of the revegetation efforts, the sites will enter long-term S&M for monitoring the success of the revegetation efforts. Any revegetation efforts subsequent to those conducted at the end of remediation will be conducted as part of long-term S&M.

D.4.2.3 Decontamination & Decommissioning Project

The Hanford Site contains many surplus facilities remaining from plutonium production activities that were required by the Department of Defense from World War II through the end of the Cold War. Those facilities are now aged and deteriorating. Because the facilities now have no production mission, they must be either maintained (to preserve their integrity) or removed to (1) preclude the escape of potentially hazardous substances into the accessible environment; or (2) prevent unacceptably hazardous conditions for the workers who must maintain them. The D&D Project responsibilities include the following:

- Managing and integrating the characterization and D&D of inactive facilities assigned to the ER Project.
- Managing and integrating the interim safe storage and final disposition of the surplus reactors.

D&D efforts at the Hanford Site will proceed on a priority-based path that results in the expedient and cost-efficient transition of facilities to a safe and stable condition (including demolition) which presents no significant threat of release of hazardous substances to the environment, and no significant risk to human health. Waste generated by the D&D project will typically be disposed at the ERDF. Facilities will be reused for economic diversification, where feasible. Reactors will placed in interim safe storage for up to 75 years, pending future removal, with reactor blocks transported to Central Plateau for disposal.

D.4.2.4 Groundwater Management Project

The Columbia River crosses the northern portion of the Hanford Site and forms the site's eastern boundary. Groundwater under the 100, 200, 300, 400, 600, and 1100 Areas has been contaminated through discharge of waste liquids to cribs, ditches, trenches, ponds, french drains, and retention basins. Currently, approximately 220 square kilometers (85 square miles) of groundwater in the uppermost aquifer exceed drinking water standards, and portions of this contaminated groundwater have reached the Columbia River.

The overall goal of the Groundwater Management Project is to restore groundwater to its intended beneficial uses in terms of protection of human health and the environment. The strategy is to contain the spread of contamination and to reduce the mass of contamination in the major groundwater plumes.

Remediation of groundwater will generally consist of groundwater extraction, surface treatment, and reinjection to the aquifer, although new technologies will be investigated and implemented based on technical merit and cost savings. Along with remediation, the Groundwater Management Project will coordinate and perform required groundwater monitoring and well decommissioning.

The Groundwater Management Project responsibilities include the following:

- Assessing the groundwater to determine the type and extent of contamination such that a ROD for remediation of the groundwater can be prepared.

- Preparing the remedial design and performing the remedial actions necessary to implement the ROD.

- Managing and integrating the numerous groundwater monitoring requirements.

- Managing and integrating groundwater well maintenance and decommissioning.

D.4.2.5 N Reactor Deactivation Project

The N Reactor Deactivation Project involves the deactivation of 88 facilities; cleanout and stabilization of the N Basin; cleanout and stabilization of the Emergency Dump Basin; removal of fuel spacers from silos; operation of the N Reactor waste pad; and performance of S&M. Wastes removed from N Reactor will be disposed at the ERDF, with N Basin water treated at the ETF. This project will be completed by July 31, 1998, to support a *Tri-Party Agreement* milestone.

D.4.3 Programs Managed by PNNL

This section summarizes programmatic information for work performed by PNNL.

D.4.3.1 Hanford Site Groundwater Monitoring Program/Surface Environmental Surveillance Program

Hanford Site groundwater monitoring and surface environmental surveillances are performed by PNNL. These activities include sample collection, analysis and reporting for groundwater, air, surface water, soil, flora, and fauna.

The Hanford Site GWMP regularly collects data on subsurface water levels, chemical constituents, water-quality parameters, and temperature from hundreds of groundwater monitoring wells in the Hanford Site. This information is entered into the Hanford Environmental Information System (HEIS) database. The data are used to assemble contaminant-plume and water table maps, and to construct hydrogeologic models of groundwater flow in the uppermost aquifer. Most of the information used by the Consolidated Site-Wide Groundwater Model Program (Section D.4.3.2) is collected by the GWMP.

The major annual milestone (and principal product) is the groundwater monitoring report. The report covers Hanford site-wide, RCRA facility, and other facility-related groundwater quality-compliance monitoring.

In contrast to subsurface monitoring described by the GWMP, The Surface Environmental Surveillance Program (SESP) collects and analyzes data from the surface environment. SESP is administered by RL's Public Safety and Resource Protection Program. SESP is an ongoing, multimedia environmental monitoring program that measures surface or near-surface concentrations of radionuclides and chemicals, and assesses the cumulative effects of these contaminants on the biosphere. The SESP monitoring program samples air, surface water (including the Columbia River), soils, native vegetation, agricultural products, fish and wildlife. The scope of SESP encompasses sampling, laboratory analyses, assessment of contaminant exposure pathways, and predictions of receptor exposures.

GWMP and SESP data are used to assess the fate, transport, and exposure of the public to radionuclides and hazardous chemicals from the Hanford Site. The GWMP and SESP assess compliance with applicable environmental quality standards and the impacts of standards-specified and site-specific contaminants on the environment. SESP data are used in mathematical models to predict radiation doses to humans and aquatic biota, and the consequent carcinogenic and non-carcinogenic risks to humans. Environmental surveillance data are also used for dose reconstruction, characterization of contaminated sites, and contaminant transport model calibration. Drivers of the SESP include DOE Orders (5400.1, 5400.2A, 5400.3, 5400.5, and 231.1), the *Clean Air Act*, the *Clean Water Act*, and *Washington Administrative Code* (Chapter 402-80, Chapter 201A).

The major annual milestone and deliverable is the annual environmental report, which addresses environmental surveillance activities and compliance issues at the Hanford Site during the preceding calendar year.

D.4.3.2 Consolidated Site-Wide Groundwater Model

The current intent of the Consolidated Site-Wide Groundwater Model program is to integrate several currently used models of groundwater flow in the uppermost aquifer beneath the Hanford Site, consolidate those models into a single, site-wide model of groundwater flow in the uppermost aquifer (or, alternatively, a pair of models to permit cross-comparisons), and reach agreement among affected parties on subsequently how to model the groundwater flow in the saturated zone.

The work includes documentation of the numerical and conceptual models and input data used, and the technical assumptions, simplifications, and other limitations. Recommendations for a consolidated groundwater model are under preparation, and a consolidated groundwater model will be developed.

Outcomes of project-specific performance and risk assessments will depend directly on the site-wide groundwater model. Among such performance and risk assessments are those being conducted by the Solid Waste, TWRS, ILAW, and Hanford Tanks Initiative programs.

D.4.4 Expectations for Future Hanford Site Conditions

This section provides an overview, based on current values, plans, and expectations of future environmental conditions at the Hanford Site and Columbia River after planned Hanford Site remediation work has been completed. The information in this section assumes that the cleanup work will be completed in accordance with all current *Tri-Party Agreement* milestones, pertinent federal and state regulations, and anticipated provisions of applicable performance assessments, RODs for Environmental Impact Statements (EISs), work plans for facility closures, and designated future land uses.

D.4.4.1 Stakeholder Preferences and Values

The land-use planning alternatives were developed in accordance with input from stakeholders during the past seven years. During the public involvement process, stakeholders identified their rankings of the relative importance of various considerations (or "values"). These importance rankings are indicative of stakeholder expectations, and for that reason are particularly important to the Integration Project. Statements of values were provided in publicly released reports authored by the Hanford Future Site Uses Working Group (FSUWG 1992), the Hanford Waste Tank Task Force (1993), and the Hanford Advisory Board (HAB). The values expressed are summarized as follows:

Future Site Uses Working Group

- Protect the Columbia River.
- Deal realistically and forcefully with groundwater contamination.
- Use the Central Plateau wisely for water management.
- Do no harm during cleanup or with new development.
- Cleanup of areas with high future-use value is important.
- Cleanup to the level necessary to enable the preferred future-use option should occur.
- Waste must be safety transported, with adequate preparation for accidents.
- Emphasis should be placed on local economic development opportunities.
- Involve the public in future decisions about the Hanford Site.

Hanford Tank Waste Task Force

- Protect the environment.
- Protect public/worker health and safety.
- "Get on with the cleanup" to achieve substantive progress in a timely manner.
- Use a systems-design approach that keeps endpoints in mind while making interim decisions.
- Establish management practices that ensure accountability, efficiency, and allocation of funds to high-priority items.

Hanford Advisory Board

- Historic and cultural resources have value and should not be degraded or destroyed. Protecting appropriate access to those resources is part of this value.

- Workforce stability and reasonable stability in the demand for public services are important factors for the well being of affected communities. In making decisions on projects and contractors, consideration should be given to effects on the local workforce and population.

- Cleanup and waste management decisions should be coordinated with efforts by the affected communities to foster more private business activity and to reduce dependence on federal projects that may have adverse environmental or economic impacts.

- The importance of ecological diversity and recreational opportunities should be recognized; those resources should be enhanced as a result of cleanup and waste management decisions.

- The concerns of stakeholders should be considered in the process of determining the most effective and efficient means to protect environmental quality, and public health and safety -- now, and for future generations.

- Cleanup activities should protect, to the maximum degree possible, the integrity of biological resources, with specific attention given to rare, threatened, and endangered species and their related habitat.

Based on these values, and other considerations, an envisioned future condition of each geographic subdivision of the Hanford Site was developed (in the HRA-EIS) for the Preferred Alternative. The subsections that follow describe these end states (future conditions), as defined by the HRA-EIS.

The following information is based largely on the *Revised Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan* (HRA-EIS; OE/EIS-0222D, April 1998). RL has consulted with federal, state, and Tribal Nations to evaluate land-use alternatives. That evaluation focused on potential environmental consequences that could result from each alternative during the next 50 years.

As stated in the HRA-EIS, *"This land use plan can be used to set a goal for the CERCLA/Resource Conservation and Recovery Act of 1976 (RCRA) cleanup (i.e., remediation processes). In turn, the CERCLA/RCRA processes evaluate the technical and economic feasibility of remediating the area to support the proposed land use."* In this context, land-use planning provides a direction and defines an ultimate destination that will be used to help guide the Integration Project. Hence, the envisioned future uses for various parts of the Hanford Site allow the Integration Project to focus on developing an understanding needed to make technically sound decisions for remedial actions and processes. The decisions, and their implementation, will either enable the future use designated in the HRA-EIS, or provide reasons for altering that planned use.

Six land use alternatives were defined by the HRA-EIS, including *No-Action*, *Preferred*, and *Alternatives 1* through *4*. For brevity, only the *Preferred* alternative is included in the following discussion. See DOE/EIS-0222D (April 1998) for a complete discussion. RL concluded that the preferred alternative would fulfill all statutory requirements, and that this alternative adequately considers economic, environmental, technical, and other factors. Figure D-9 shows the nine land-use designations for the preferred alternative (DOE/EIS-0222D, 1998).

D.4.4.2 Major Provisions of the Comprehensive Land Use Plan

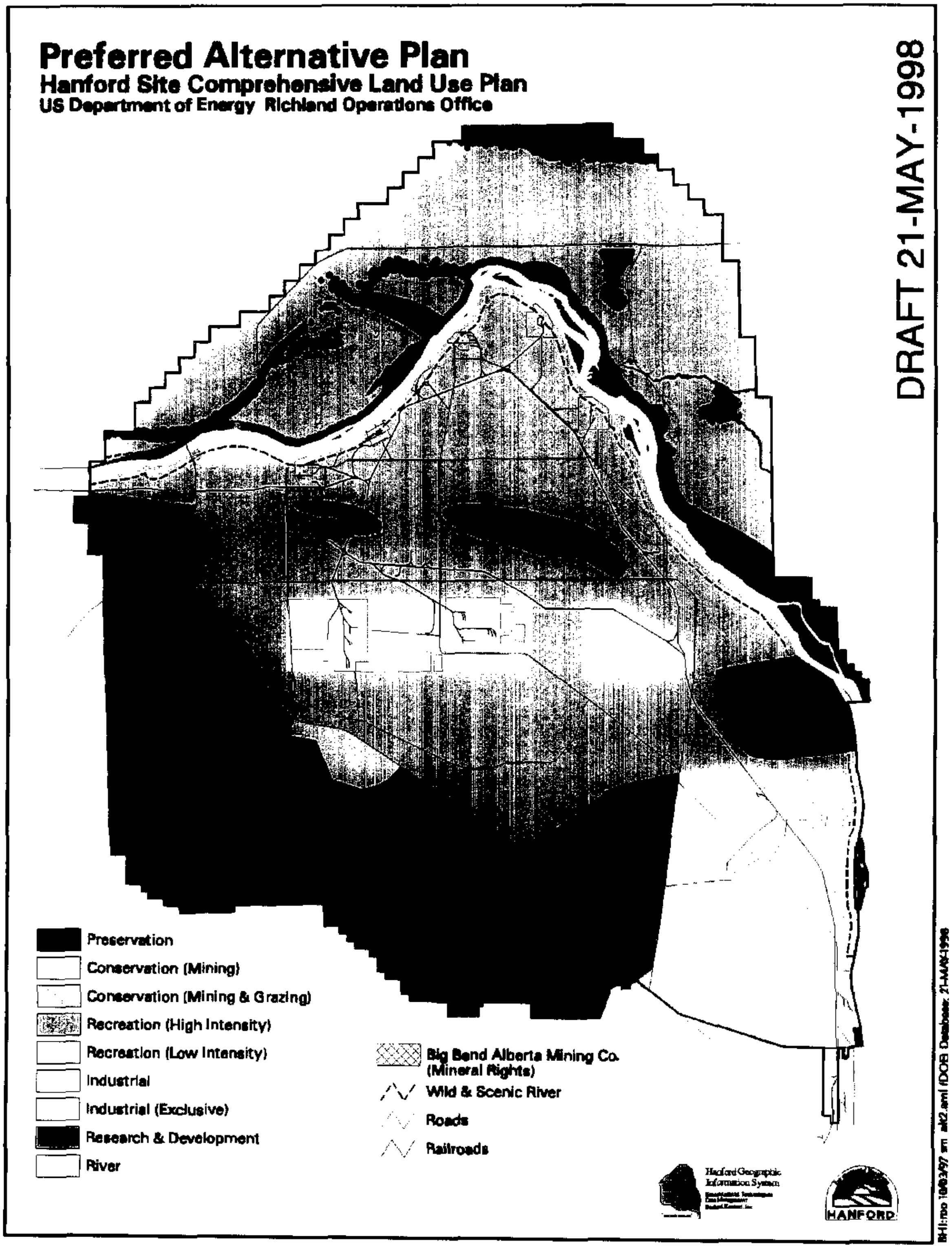
Land-use planning sections of the HRA-EIS discuss the processes and considerations used to (1) designate portions of the Hanford Site as suitable for specified uses; and (2) select a preferred-use designation for each specified geographic area. The land-use planning sections of the HRA-EIS address a 50-year period, as mandated by law, and define a framework for making land-use and facility-use decisions. The HRA-EIS lists nine land-use designations and six land-use alternatives, geographically subdividing the Hanford Site into the *Wahluke Slope, Columbia River Corridor, Central Plateau, All Other Areas,* and the *Arid Lands Ecology Reserve* (ALE Reserve). Because the Integration Project will have little or no effect on future land uses of the Wahluke Slope and ALE Reserve, these areas are only minimally discussed in the sections that follow.

The nine land-use designations applied to these five geographic subdivisions are defined in Table 4-1 (from the HRA-EIS). They include *Industrial-Exclusive, Industrial, Agricultural, Research and Development, High-Intensity Recreation, Low-Intensity Recreation, Conservation (Mining and Grazing), Conservation (Mining), and Preservation*. The adoption of different land-use designations or changes in the current boundaries for future-use restrictions could affect cleanup requirements. Therefore, such changes could alter the focus of actions and direction undertaken by the Integration Project to obtain the understanding required for technically sound remediation decisions related to future land use.

D.4.4.3 Columbia River Corridor

As stated in several reports (e.g., *Decommissioning of Eight Surplus Reactors*, DOE 1992), remediation and restoration of the Columbia River corridor will result in its return to a non-developed, natural condition. However, some local use restrictions may be necessary to prevent or retard the mobilization of residual contaminants in the soil; for example, prohibition of discharge of water to the soil. According the existing ROD, the surplus reactors states will be demolished, and the reactor blocks will be moved to the Central Plateau. These actions will not to be completed until the year 2067.

Figure D-9. HRA-EIS Preferred Alternative Land Use Designations.



The following land-use designations apply to the Columbia River corridor:

High Intensity Recreation. This designation applies to four sites: (1) the B reactor would be converted into a museum, and the surrounding area would be made available for museum support facilities; (2) the recreation area near Vernita Bridge would be expanded across Highway 240; and (3) two areas of the Wahluke Slope would be potentially designated as exclusive tribal fishing villages.

Low Intensity Recreation. The area west of B reactor would be used as a corridor between the high-intensity recreation areas associated with B reactor and the rest stop and boat ramp near Vernita Bridge. Between the H and F Reactors, the White Bluffs boat launch would provide recreational boating facilities. Near the old Hanford High School, access would be provided for such visitor activities as hiking and biking. Trails for these activities would be developed along the Hanford Reach of the Columbia River. Hiking and biking trails would also exist north of the present Washington Public Power Supply (WPPSS) power generating facilities.

Conservation. For the remainder of the Hanford Site shoreline area along the Columbia River corridor (i.e., the current 100 Areas), mining of aggregate and/or grazing would be allowed through permits. Grazing permits would be issued to reduce fire hazards and control weeds. Aggregate mining would be allowed only to support construction activities associated with the cleanup mission. Management of some or all of these lands would be transferred to the Department of Interior (DOI). The DOI would determine if the "privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land" would be extended to Native Americans.

Preservation. This usage designation for Columbia River islands is consistent with the ROD for the Hanford Reach EIS (NPS 1996). Remediation activities would continue in the 100 Areas (i.e., the 100-BC, -KE, -KW, -N, -D, -DR, -H, and -F areas), and would be considered a preexisting, non-conforming interim activity in the areas with a preservation designation.

D.4.4.5 Central Plateau

Future use of the Central Plateau (200 Areas) would be restricted to industrial-exclusive, to allow for continued waste management operations and to protect public health and safety. This designation would permit expansion of the current major radioactive waste management and disposal facilities, or construction of new radioactive waste management and disposal facilities. Industrial-exclusive land-use designation for the Central Plateau is consistent with FSUWG recommendations, current DOE management practice, other governmental recommendations to protect public health and safety, and many stakeholder values.

For other, miscellaneous waste disposal sites within the Central Plateau, several notices of deed restriction have been placed with the Benton County Assessor's Office and the Benton County Planning Office to limit future usage of these areas. These waste disposal sites are landfills containing asbestos and surface-contaminated concrete rubble transported from the 100 Areas.

D.4.4.6 All Other Areas

Within all the other geographic subdivision areas of the Hanford Site, the preferred alternative would include industrial, research and development, high-intensity recreation, low-intensity recreation, conservation, agricultural, and preservation land-use designations.

Within several areas generally designated as suitable for conservation (i.e., allowing mining and grazing), aggregate mining and grazing probably would not be allowed. Consequently, a notice of deed restriction would be issued for those locations within the conservation land-use designation, where residual vadose zone contamination is judged by the CERCLA ROD or RCRA *Closure Permit* as likely to remain. The effect of the deed restriction would be to foreclose the mining option.

Conservation (mining and grazing). Usage of the section of land within the Hanford Site that is owned and leased by the state of Washington to U. S. Ecology would continue to be limited by deed restrictions to waste management activities.

Industrial Use. The May Junction area, east of the 200 East Area and north of Richland, would continue to be used for industrial development and/or expansion of the facilities currently used by the WPPSS on land leased from RL. Other industrial use designations include most of the 300, 400, and 100 Areas, and the Hanford Patrol training area.

Research and Development. An area west of State Highway 10 and east of State Highway 240 would continue to be used for research and development, based on its current use (Laser Interferometry Gravity Observatory [LIGO] research facilities).

Agricultural. Much of the Wahluke slope not designated for other uses would be made available for agriculture.

Preservation. Gable Mountain, Gable Butte, the land between Umtanum Ridge and the ALE Reserve, the ALE Reserve, and the active sand dunes of the Hanford Site would be designated for preservation because of their ecologic sensitivity and relatively pristine condition. (A small portion of this general area would be designated as suitable for Conservation during remediation activities.)

Table D-2 Hanford Site Land-Use Designations.

Land-Use Designation	Definition
Industrial-Exclusive	An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes. Includes related activities consistent with Industrial-Exclusive uses.
Industrial	An area suitable and desirable for activities including reactor operations, rail, barge transport facilities, mining, manufacturing, food processing, assembly, warehouse, and distribution operations. Includes related activities consistent with Industrial uses.

Table D-2 Hanford Site Land-Use Designations.

Land-Use Designation	Definition
Agricultural	An area designated for the tilling of soil, raising of crops and livestock, and horticulture for commercial purposes, along with all those activities normally and routinely involved in horticulture and the production of crops and livestock. Includes related activities consistent with Agricultural uses.
Research and Development	An area designated for conducting basic or applied research that requires the use of a large-scale or isolated facility. Includes scientific, engineering, technology development, technology transfer, and technology deployment activities to meet regional and national needs. Includes related activities consistent with Research and Development.
High-Intensity Recreation	An area allocated for high-intensity, visitor-serving activities and facilities (commercial and governmental), such as golf courses, recreational vehicle parks, boat-launching facilities, Tribal fishing facilities, destination resorts, cultural centers, and museums. Includes related activities consistent with High-Intensity Recreation.
Low-Intensity Recreation	An area allocated for low-intensity, visitor-serving facilities, such as improved recreational trails, primitive boat-launching facilities, and permitted campgrounds. Includes related activities consistent with Low-Intensity Recreation.
Conservation (Mining and Grazing)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining and grazing could occur as a special use (e.g., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining and Grazing), consistent with the protection of archeological, cultural, ecological, and natural resources.
Conservation (Mining)	An area reserved for the management and protection of archeological, cultural, ecological, and natural resources. Limited and managed mining could occur as a special use (e.g., a permit would be required) within appropriate areas. Limited public access would be consistent with resource conservation. Includes activities related to Conservation (Mining), consistent with the protection of archeological, cultural, ecological, and natural resources.
Preservation	An area managed for the preservation of archeological, cultural, ecological, and natural resources. No new consumptive uses (e.g., mining) would be allowed within this area. Public access controls would be consistent with resource preservation requirements. Includes activities related to Preservation uses.

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APPENDIX E

APPLICABLE CRCIA REQUIREMENTS AND GUIDELINES

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